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The Black Flies (Diptera: Simuliidae) of Saskatchewan

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The Black Flies (Diptera: Simuliidae) of Saskatchewan

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ABSTRACT

Thirty-one species of black flies are known to occur in Saskatchewan. Six of these regularly attack people, two are notorious pests of domestic animals and many species attack only birds. Keys to identify the pupae, females and males are provided as well as annotated distribution maps.

INTRODUCTION

This report is based mainly upon field collections, 1947 through 1983. Significant changes in the distribution of some species during that interval are discussed.

Black flies are small blood-sucking Diptera (two-winged flies), closely related to mosquitoes and Culicoides. They often were called sand flies or swamp flies by early settlers who believed that massive outbreaks originated from those sites when in fact adjacent rivers were the sources. They also were called buffalo gnats, perhaps because of their humped backs or because they were

observed attacking buffalo.

LIFE CYCLES, BEHAVIOR AND ECONOMIC IMPORTANCE

The females of many species of black flies, like mosquitoes, require bloodmeals to nourish developing eggs. Unlike mosquitoes however, larvae and pupae of black flies occur only in running water. Practically every stream and river in the entire temperate and tropical zones of the world are home to one or many species.

Females of only about six of the 31 species known to occur in Saskatchewan readily attack people. These are Ectemnia taeniatifrons, a rare species that emerges from the Saskatchewan River in May each year, and Simulium decorum, S. griseum, S. luggeri, S. tuberosum and S. venustum. S. vittatum sometimes swarms densely around people but bites only non-hominid animals. S. arcticum and S. luggeri are most notorious for their attacks on domestic animals.

S. arcticum used to breed abundantly in rapids in the Saskatchewan River and still breeds abundantly in the Athabasca River in Alberta. Outbreaks at one time or another have affected livestock in some 75,000 km^2 of farmlands, mainly in Saskatchewan.

The earliest settlers on the prairies experienced losses of livestock due to black fly outbreaks. The late Mr. J.T. Mawson who homesteaded just west of Dundurn, some 35 km south of Saskatoon, reported to me in 1947, that an outbreak, presumably of S. arcticum in 1886, killed six cattle, an ox and two horses on his and two neighbor's farms. Outbreaks probably were annual events, as my records since 1947 suggest, but few reports of earlier years exist. Cameron (1922) reported that about 100 cattle were killed near Duck Lake in 1913. Rempel and Arnason (1947) reported that about 300 cattle had been killed in 1913 and that large losses also occurred in 1919 and 1930. The most devastating series of outbreaks occurred in 1944 (133 animals killed), 1945 (70), 1946 (over 600) and 1947 (210) (Fredeen, 1977 (a)). In 1947 there were fatalities as far south as Kenaston and Foam Lake, from outbreaks originating in the Saskatchewan River.

S. arcticum was largely, but not completely, replaced by S. luggeri in the Saskatchewan River when both branches of that river became shallow and weedy every summer since the 1960s due to impoundments of water in reservoirs created to store water to serve hydroelectric turbines in the winter (Fredeen 1977 (b)). Severe outbreaks of S. luggeri commenced in 1976 and often spread out in Saskatchewan as widely as had those of S. arcticum. The most damaging outbreaks occurred in 1978 when financial losses to livestock producers were estimated to have exceeded $2,900,000

(Fredeen, 1984). Although the toxins injected by S. luggeri appear less harmful to animals than those of S. arcticum, losses are inflicted because the species is capable of cycling continuously all summer, females develop abundantly in extensive weed beds in the Saskatchewan River, they can be carried great distances on the wind, and they swarm densely around herds of animals causing panic, increased incidence of stress-related diseases, and interruptions of grazing and breeding activities. People also are attacked and sometimes driven indoors despite use of repellents.

Poultry are attacked by at least three species: S. euryadminiculum, S. meridionale, and S. rugglesi. Occasional losses near the Battle River, Saskatchewan River and small streams near Bangor and Langbank have been attributed to loss of blood due to attacks by S. meridionale. However, some species of black flies are known vectors of blood parasites fatal to birds (especially Leucocytozoon parasites), and continuing research eventually may show these are involved here as well. Wild birds are often infected by various kinds of blood parasites transmitted by these and several other bird-biting species of black flies (Fallis (1964), Greiner et al (1975)). Anderson (1956) described the life cycle of one species of microfilaria (roundworm) transmitted to ducks by black flies. Occasionally deer, horses and cattle also are infected by microfilariae transmitted by

black flies and other biting flies. We are fortunate here in the temperate areas of North America not to have species of black flies that transmit microfilariae or other blood parasites to people. In tropical Africa and the Americas more than 20 million people are said to be infected with microfilariae to the extent that their productive lives are greatly shortened.

Black fly larvae are uniquely adapted to a wide range of flowing-water habitats. S. vittatum larvae inhabit the widest variety of stream conditions ranging from warm, organically rich rivers to cool, relatively clear streams. Larvae of S. arcticum attach themselves to surfaces of clean rocks in swiftly-flowing sections of large mountain-fed rivers and some permanent streams such as Battle Creek in the Cypress Hills and Old Man River north of Lake Athabasca. Larvae of S. luggeri attach mainly to vegetation in slower-flowing portions of the Saskatchewan River and in smaller rivers such as the Battle and Torch Rivers in central Saskatchewan. However about two-thirds of our species breed mainly in small spring or lake-fed streams, often in wooded areas.

Larvae are filter-feeders, capturing microscopic food particles including bacteria (Fredeen (1964)) with the aid of delicate mouth fans. Larvae develop through six or seven instars and attain lengths of 5 mm or more, generally within three or four weeks before spinning cocoons and pupating within them. In about

four days at summer temperatures adults emerge from the pupae and immediately take wing in search of resting sites and the nectar meals that are required for flight energy. Mating generally occurs in swarms in the air (on the ground for C. dacotensis). I have observed swarms of S. arcticum as far away as 65 km from the nearest breeding sites.

After mating, females of most species seek blood meals from whatever species of host animals or birds they are instinctively attracted to. Sight as well as sensitivity to heat, moisture and certain chemicals such as carbon dioxide help them in their search. S. vittatum females are unique in that they generally enter ears of animals for blood meals and strangely enough are tolerated by the animals. S. luggeri is notorious for its vigorous swarming attacks, especially around the heads of most mammals whereas S. arcticum attacks mainly along undersides. The several species breeding in small streams attack mainly birds. At least one of our species C. dacotensis, produces eggs from nutrients stored during larval stages. It cannot take blood because of ineffective mouthparts.

Females of most species apparently lay a single batch of several hundred eggs. Some females of blood-sucking species live long enough to take second or even third blood meals but those batches of eggs are smaller. Most species lay eggs in communal masses at

the water line on vegetation or rocks. S. arcticum and perhaps S. luggeri scatter eggs in flight over surfaces of rivers (Fredeen et al (1951)). The eggs are white at first but soon become golden and eventually dark brown. Eggs of many species hatch within four days or so during summer months. Others enter a diapause state and do not hatch until the following spring. Most species spend the winter as eggs buried in river beds. Larvae from those eggs produce first-cycle adults between mid-May and mid-June. Some species, notably E. taeniatifrons and S. vittatum overwinter as partly grown larvae. Adults from these emerge soon after ice break-up in the spring. At La Ronge early swarms of newly-emerged S. vittatum have been known to swarm so densely around people as to cause alarm even though the females apparently do not bite them. Many species of Simulium complete more than one life cycle each summer, other species only one.

METHODS

Specimens for systematic studies generally were obtained by rearing adults from pupae so as to associate those two stages of the life cycle. Last-stage larvae can be associated with pupae by dissecting out and examining their pupal respiratory-tuft histoblasts. Thus a key for species of pupae, but not larvae, is included herein (Appendix B). Pupae were easily cultured by placing them, in their cocoons, individually in small vials on moist blotting paper. An adult was allowed to harden its cuticle

for a few hours before being attached, with its associated pupal pelt and cocoon, to a pin labelled as to source and date. To prevent shrinking on drying, freshly pinned specimens were frozen when possible until thoroughly dry (several months).

Most of the specimens upon which the keys are based were collected from agricultural areas of southern Saskatchewan. Streams and rivers near Uranium City in northwestern Saskatchewan were briefly surveyed twice but the remainder of the province north of the Churchill River was poorly surveyed. Our collections are stored at the Canada Agriculture Research Station, Saskatoon and at the Biosystematics Research Institute, Ottawa.

Generic and subgeneric names considered valid by Crosskey (1981) and D . M. Wood (1984) are used in these keys. Genera are arranged in the list (Appendix A) in the phylogenetic order suggested by Stone (1965). Subgenera and species are listed in alphabetical order. Detailed comparisons of banding patterns and other features of polytene chromosomes of black fly larvae during the past 25 years have provided unequivocal evidence that many of the presently recognized species of black flies in Canada are actually complexes of closely related species (Rothfels, 1979). Species presently recognized as complexes are so indicated in the list.

I left S. piperi in the subgenus Simulium even though there are striking similarities in the morphologies of all stages of the life cycle between S. vittatum and S. piperi. I asked Dr. V. Golini to compare polytene chromosomes between these two species and he reported (1983) "to my surprise, S. piperi is closer to S. vittatum (than certain Eusimulium species) both of which have the nucleolar organizer in IIs, and even though morphologically the larvae and pupae resemble certain Eusimulium species".

The keys (Appendix B) are based upon unpublished typescript keys produced by the author entitled "Keys to the black flies (Diptera: Simuliidae) of Manitoba, Saskatchewan and Alberta", in use in Western Canada since 1963.

Figures 1 to 27 of basic structures used in these keys were adapted from F. J. H. Fredeen (1981).

Many of the notes attached to the distribution maps of rare species were obtained from Davies et al (1962).

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APPENDIX A

LIST OF SPECIES OF BLACK FLIES KNOWN TO OCCUR IN SASKATCHEWAN

	MAP NO.
Prosimulium (Parahelodon) decemarticulatum (Twinn)	1
Prosimulium (Parahelodon) gibsoni (Twinn)	2
Prosimulium (Prosimulium) fuscum Syme and Davies	3
Cnephia dacotensis (Dyar and Shannon)	4
Ectemnia taeniatifrons (Enderlein)	5
Metacnephia saskatchewana (Shewell and Fredeen)	6
Stegopterna mutata (Malloch) (species complex)	7
Simulium (Byssodon) meridionale Riley	8
Simulium (Eusimulium) aureum Fries (species complex)	9
Simulium (Eusimulium) croxtoni Nicholson and Mickel	10
Simulium (Eusimulium) duplex Shewell and Fredeen	11
Simulium (Eusimulium) euryadminiculum Davies	12
Simulium (Eusimulium) furculatum (Shewell)	13
Simulium (Eusimulium) pugetense (Dyar and Shannon)	14
Simulium (Eusimulium) vernum Macquart	15
Simulium (Psilopelmia) bivittatum Malloch	16
Simulium (Psilopelmia) griseum Coquillett	17
Simulium (Psilozia) vittatum Zetterstedt (species complex)	18
Simulium (Shewellomyia) longistylatum Shewell	19

	MAP NO.
Simulium (Simulium) arcticum Malloch (species complex)	20
Simulium (Simulium) corbis Twinn (species complex)	21
Simulium (Simulium) decorum Walker	22
Simulium (Simulium) hunteri Malloch	23
Simulium (Simulium) luggeri Nicholson and Mickel	24
Simulium (Simulium) malyshevi Dorogostajskij, Rubtsov and Vlasenko	25
Simulium (Simulium) piperi Dyar and Shannon	26
Simulium (Simulium) rugglesi Nicholson and Mickel	27
Simulium (Simulium) transiens Rubtsov	28
Simulium (Simulium) tuberosum (Lundstrom) (species complex)	29
Simulium (Simulium) venustum Say (species complex)	30
Simulium (Simulium) verecundum Stone and Jamnback (species complex)	31

APPENDIX B

KEYS TO SPECIES OF BLACK FLIES IN SASKATCHEWAN

PUPAE

1. Apex of abdomen with a pair of prominent spines, much longer than wide and curved or twisted anteriorly--------- 2
   Terminal spines, if present on abdomen, scarcely longer than wide and generally directed dorsally or posteriorly-- 4

2. Respiratory organ with 16 filaments, parallel to each other from near base ----------*Prosimulium fuscum*
   Respiratory organ with nine or 14 filaments, diverging widely from base ---------- 3

3. Respiratory organ with nine filaments----*P. decemarticulatum*
   Respiratory organ with 14 filaments ----------*P. gibsoni*

4. Respiratory filaments 10, stout with converging apices; cocoon attached to slender stalk of silk and detritus; (Saskatchewan River) ----------*Ectemnia taeniatifrons*
   Respiratory filaments numbering less or more than 10, or if 10 (one species) then not converging at tips; cocoon spun directly on substrate ---------- 5

5. Cocoon loosely woven and without a thickened anterior rim (or in one species a thin transparent sheath without visible threads, and with an elevated anterior rim); terminal segment of abdomen with short, curved, single, double, or triple hooks ---------- 6
   Cocoon with a well-defined anterior margin; terminal segment of abdomen lacking curved hooks although setae may be present ---------- 8

6. Respiratory organ with 12 filaments ------*Stegopterna mutata*
   Respiratory organ with more than 12 filaments ---------- 7

7. Respiratory organ with 17 or 19 filaments; cocoon boot-shaped; terminal hooks on abdomen minute ----------*Metacnephia saskatchewana*
   Respiratory organ with 27 to 40 filaments; cocoon slipper-shaped; terminal hooks on abdomen large ----------*Cnephia dacotensis*

8. Anterodorsal margin of cocoon with either a median lobe or a prominent median projection ---------- 9
   Anterodorsal margin of cocoon without a prominent median projection ----------13

9. Respiratory organ with four filaments----------10
   Respiratory organ with more than four filaments----------11

10. Anterodorsal projection on cocoon sometimes scarcely visible ----------*Simulium aureum*
    Anterodorsal projection on cocoon about half as long as remainder of cocoon ----------*S. vernum*

11. Respiratory organ with eight filaments----------12
    Respiratory organ with nine to 13 filaments (Cypress Hills) ----------*S. piperi*

12. Anterodorsal median projection on cocoon about one-third as long as remainder of cocoon; cocoon loosely woven anteriorly ----------*S. croxtoni*
    Anterodorsal median projection on cocoon merely a prominent rounded lobe; cocoon tightly woven ----------*S. furculatum*

13. Cocoon boot-shaped (with the anterior opening distinctly elevated from the base by a broad collar) ----------14
    Cocoon slipper-shaped (with the anterior opening not elevated from the base) ----------17

14. Cocoon loosely-woven throughout; 5 to 6 mm long; nine respiratory filaments ----------*S. longistylatum*
    Cocoon loosely-woven only around the collar; less than 5 mm long; 10 or more respiratory filaments ----------15

15. Respiratory organ with 10 filaments (northern Saskatchewan) ----------*S. corbis*
    Respiratory organ with more than 10 filaments ----------16

16. Respiratory organ with 12 filaments (all of Saskatchewan) ----------*S. arcticum*
    Respiratory organ with 16 filaments (northwestern Saskatchewan) ----------*S. malyshevi*

17. Respiratory organ with two stout filaments, with one or both filaments dividing once near tips ----------*S. duplex*
    Respiratory organ with more than two filaments ----------18

18. Respiratory organ with four filaments----------19
    Respiratory organ with more than four filaments----------21

19. Respiratory filaments parallel to each other from base ----------*S. pugetense*
    Respiratory filaments diverging by about 90° at base before projecting anteriorly ----------20

20. Cocoon 4 to 5 mm long and tightly woven with few openings; ventral respiratory filament about one-half the diameter of the other three ----------S. euryadminiculum
Cocoon 2.5 to 3 mm long and loosely woven with many small openings; all four filaments about the same diameter ----------S. transiens

21. Respiratory organ with six filaments ----------22
Respiratory organ with more than six filaments ----------24

22. Pupa and cocoon relatively dark and small (cocoon generally shorter than 3.5 mm); respiratory filaments less than one-half as long as cocoon, fine, spreading scarcely wider than 90° at base before projecting anteriorly ----------S tuberosum
Pupa and cocoon relatively pale and large (cocoon generally longer than 3.5 mm); respiratory filamemts more than half as long as cocoon and spreading wider than 90° near base ----------23

23. Respiratory filaments spreading out about 90° at the base before projecting anteriorly; relatively fine ----------S.venustum
Respiratory filaments spreading out as much as 180° at the base before projecting anteriorly; relatively coarse ----------S.verecundum

24. Respiratory organ consisting of eight filaments ----------25
Respiratory organ consisting of more than eight filaments ----------28

25. Respiratory organ divided into four pairs of filaments from base ----------26
Respiratory organ divided into two and six (2 + 1 and 1 + 2) filaments at the base ----------27

26. Respiratory filaments slender, arranged in four long-petiolate pairs; cocoon finely woven ----------S. rugglesi
Respiratory filaments coarse, arranged in four short-petiolate pairs (two filaments often arising singly); cocoon coarsely woven ----------S. decorum

27 Respiratory filaments spreading 60° to 70° at the base before projecting anteriorly (South Saskatchewan River) ----------S. griseum
Respiratory filaments spreading about 90° at the base before projecting anteriorly (South Saskatchewan River) ----------S. bivittatum

28. Respiratory organ consisting of 12 filaments -----S. luggeri
Respiratory organ consisting of more than 12 filaments ---29

29. Respiratory organ consisting of 16 filaments (entire province) ----------S. vittatum
Respiratory organ consisting of more than 16 filaments ---30

30. Respiratory organ consisting of 22 to 26 filaments ----------S. meridionale
Respiratory organ consisting of a dense tuft of about 125 filaments (Cypress Hills) ----------S. hunteri

FEMALES

1. Costa with fine hairs only, no stout spinules; radial sector deeply forked; hind tarsus without calcipala or pedisulcus ---------- 2
Costa generally with spinules mixed in with fine hairs; radial sector unbranched (or rarely with a suggestion of a branch at extreme apex); calcipala usually present on hind basitarsus; pedisulcus usually present on second hind tarsal segment ---------- 4

2. Claw with minute basal tooth ----------P. fuscum
Claw with conspicuous basal tooth about half as long as claw ---------- 3

3. Antenna nine-segmented; antenna and legs dark brown comparable to rest of body ----------P. gibsoni
Antenna 10-segmented; antenna and legs orange-yellow, contrasting with the dark brown body ----P. decemarticulatum

4. Basal cell in wing usually present; basal portion of vein R distinctly longer than one-third remaining distance to wing tip; vein R covered with hairs dorsally ---------- 5
Basal cell in wing absent; basal portion of vein R shorter than one-third remaining distance to wing tip; vein R may or may not be covered with hairs dorsally ---------- 8

5. Tarsal claw simple or with a minute basal tooth ---------- 6
Tarsal claw with a thumb-like basal tooth, half as long as claw ---------- 7

6. Tarsal claw simple ----------Stegopterna mutata
Tarsal claw with a minute basal tooth ----Cnephia dacotensis

7. Frons with nearly parallel sides, narrowest at the middle; wing 4.0 to 4.5 mm long ----------Ectemnia taeniatifrons
Frons somewhat wedge-shaped, narrowest ventrally; wing 2.0 to 3.0 mm long ----------Metacnephia saskatchewana

8. Vein R clothed with hairs dorsally ---------- 9
Vein R bare dorsally ----------15

9. Claw simple or with a minute basal tooth ----------*Simulium furculatum*
Claw with a large, thumb-like basal projection ----------10

10. Postnotum with two patches of golden hair (usually 20 or more hairs in each patch); basal two-thirds of tibia (integument and vestiture) yellow, contrasting with the distal black portion ----------*S. aureum*
Postnotum bare (except 10 or fewer hairs in *vernum*), tibia not as above ----------11

11. Katepisternum with a few hairs along the dorsal margin (sockets visible in rubbed specimens after clearing) ----------*S. croxtoni*
Katepisternum bare ----------12

12. Hair of abdomen silver-white, dense laterally and obscuring the integument, but absent on the black, dorsolateral areas of segments three and four ----------13
Hair of abdomen yellow or brown, sparse, not obscuring integument; dorsolateral areas of segments three and four not usually contrastingly black and bare ----------14

13. Median and two lateral vittae on scutum narrow, white ----------*S. euryadminiculum*
Median and two lateral vittae on scutum narrow, black ----------*S. duplex*

14. Hair on scutum uniformly pale yellow; frons about 1.5 times wider than basal segment of antenna ----------*S. pugetense*
Hair on central part of scutum golden, contrasting with the paler hairs on the anterior and lateral margins; frons scarcely wider than basal segments of antenna -----*S. vernum*

15. Claw with large thumb-like basal projection ----------16
Claw simple or with a minute sub-basal tooth ----------18

16. Fore leg entirely dark; width of frons at narrowest point about one-quarter the length of the frons; frons and terminal abdominal tergites grey-pollinose; scutum densely grey-pollinose with three narrow, brown vittae ----------*S. meridionale*
Fore coxa and about three-quarters of tibia pale yellow; width of frons at narrowest point about one-half the length of the frons; frons and terminal abdominal tergites shining dark brown; scutum thinly grey-pollinose, subshining and without three narrow, brown vittae --------17

17. Scutum thinly grey-pollinose with a broad brownish-pollinose band occupying median half; hairs on scutum short, silvery; ventral surface of subcosta bare, basal three segments of antenna distinctly paler than rest of antenna ----------S. rugglesi
Scutum thinly pollinose, subshining; hairs on scutum relatively long, golden; ventral surface of subcosta with a row of hairs; entire antenna dark brown ------S. transiens

18. Small yellowish flies with postnotum contrastingly dark and with dark dorsal spots on abdomen and ends of some leg segments ----------19
Greyish or brownish flies, mostly without strongly contrasting dark markings ----------20

19. Scutum orange with two broad, silvery-pollinose vittae providing a pattern of five alternate orange and silver bars of equal width ----------S. bivittatum
Scutum greenish-grey to dark brown, with two large silvery-pollinose spots at the front edge and three narrow, pale vittae providing a pattern of alternate dark and pale vittae of unequal widths ----------S. griseum

20. Scutum distinctly striped with a light and dark pattern---21
Scutum not distinctly striped (indistinct vittae may be seen at certain angles of view) ----------24

21. Claw with a minute basal tooth; hair on stem vein dark; integument dark with a thin grey pollinosity ----------22
Claw simple; hair on stem vein pale, occasionally with a few dark hairs; integument dark with dense, silvery-white pollinosity ----------23

22. Fore coxa and trochanter dark; frons silvery-opaque (Cypress Hills) ----------S. piperi
Fore coxa and trochanter yellow; frons shining black (Cypress Hills) ----------S. hunteri

23. Median line on scutum broader than antenna, edges diffuse; subcosta usually bare ventrally, occasionally with one to three hairs; fore tibia with a conspicuous, broad, white patch anteriorly, extending two-thirds the length of the tibia; abdomen with a distinctive black and grey patter; (widely distributed throughout entire area) -----S. vittatum
Median line on scutum narrower than antenna, edges sharp; subvcosta with a row of hairs ventrally; fore tibia without a white patch anteriorly; abdomen without a distinct black and grey pattern; (species apparently restricted to Precambrian Shield) ----------S. longistylatum

24. Claw with minute sub basal tooth ----------25
Claw simple ----------27

25. Hairs on scutum golden; entire antenna dark; entire hind femora dark (northwestern Saskatchewan) --------S. malyshevi
Hairs on scutum silvery-white; some segments of antenna relatively pale; hind femora distinctly bicolored --------26

26. Hind femora about one-quarter pale, distal three-quarters dark (all of province) ----------S. arcticum
Hind femora about four-fifths pale, only distal tip dark (northern Saskatchewan) ----------S. corbis

27. Wing generally without hairs on ventral surface of subcosta (a few hairs on occasional specimens) ----------S. luggeri
Wing with a row of 10 or more hairs on ventral surface of subcosta ----------28

28. Frons and terminal abdominal tergites distinctly greyish pollinose; anal lobe large, subquadrate, narrow dorsally, greatly broadened ventrally, anteroventral margin rounded, with a short posteroventral projection under cercus ----------S. decorum
Frons and terminal abdominal tergites shining black or brown with a thin pollinosity; anal lobe not as above ----29

29. Fore coxa, trochanter, and entire femora as dark as basitarsus; hairs on stem vein and base of costa dark; entire antenna dark; a small, dark species with a wing length of about 2 mm ----------S. tuberosum
Fore coxa, trochanter and proximal portion of femora distinctly paler than basitarsus; hairs on stem vein and base of costa relatively pale; pedicel of antenna paler than remainder; general size and color variable but abdomen relatively pale ventrally ----------30

30. Medial margins of ovipositor flaps straight and slightly diverging distally; anterior margin of anal lobe not noticeably more sclerotized than rest of lobe ---S. venustum
Medial margins of ovipositor flaps concave, with an oval space between them; anterior margin of anal lobe noticeably more sclerotized than rest of lobe -------S. verecundum

MALES

1. Costa with fine hairs only, no stout spinules; radial sector forked; hind tarsus without calcipala or pedisulcus; ----------*Prosimulium*
   Costa generally with spinules mixed in with the fine hairs; radial sector unbranched; calcipala usually present on hind basitarsus; pedisulcus usually present on second hind tarsal segment ---------- 4

2. Gonostylus with two or three apical spines --------*P. fuscum*
   Gonostylus with a single apical spine ---------- 3

3. Antenna 10-segmented ----------*P. decemarticulatum*
   Antenna nine-segmented ----------*P. gibsoni*

4. Basal cell in wing usually present; basal portion of vein R distinctly longer than one-third remaining distance to wing tip; vein R covered with hairs dorsally ---------- 5
   Basal cell in wing never present; basal portion of vein R distinctly shorter than one-third remaining distance to wing tip; vein R may or may not be covered with hairs dorsally; *Simulium* ---------- 8

5. Gonostylus with one terminal tooth ----------6
   Gonostylus with two terminal teeth ----------7

6. Gonocoxite about twice as long as wide ---*Cnephia dacotensis*
   Gonocoxite length and width about equal *Metacnephia saskatchewana* ---------- 2

7. Scutum blackish-brown; (small stream species) ----------*Stegopterna mutata*
   Scutum brownish (river species) ------*Ectemnia taeniatifrons*

8. Vein R clothed with hairs dorsally ----------9
   Vein R bare dorsally ----------15

9. Postnotum with postero-medial patch of golden scale-like hairs; ventral plate Y-shaped (laterally compressed into a narrow median keel) with widely-divergent arms; gonostylus less than half as long and side as gonocoxite and acutely bent medially ----------*Simulium aureum*
   Postnotum bare; ventral plate tongue-shaped, ventro-dorsally compressed and much wider than long (exclusive of basal arms); gonostylus approximately same size as gonocoxite, variously shaped ----------10

10. Scutum densely grey-pollinose when viewed from anterior with dorsal illumination, and with three narrow black vittae under horizontal, anterior illumination; gonostylus tapered and curved rather uniformly to a rounded tip with an apical tooth ----------11
Scutum blackish when viewed from anterior with dorsal illumination, sometimes with indistinct pale vittae under horizontal, anterior illumination; gonostylus not uniformly tapered but generally truncate, with tooth at tip directed medially, approximately at right angles to proximal part of gonostylus ----------12

11. Ventral plate rectangular, more than two times wider than base of gonostylus, ventral surface bare, shining, and slightly concave; pleural tuft dark ------S. euryadminiculum
Ventral plate conical, about same width as base of gonostylus, ventral surface clothed in long pale bristles and strongly convex; pleural tuft pale ----------S. duplex

12. Hind basitarsus about five times longer than wide; three or four endoparameral hooks on each side ------S. furculatum
Hind basitarsus not more than four times longer than wide; one endoparameral hook on each side ----------13

13. Ventral plate with a distal median nipple that is distinctively clothed in bristles ----------14
Ventral plate without a distal median nipple ------S. vernum

14. Pleural tuft whitish; abdominal fringe pale -----S. croxtoni
Pleural tuft dark brown; abdominal fringe medium brown ----------S. pugetense

15. Gonostylus short, with three or more teeth; ventral plate tongue-shaped; postnotum with two silver-pollinose vittae (entire province) ----------S. vittatum
Gonostylus with one or no teeth; ventral plate variously shaped; postnotum usually without distinct vittae --------16

16. Gonostylus flat, quadrangular, shorter than gonocoxite; ventral plate broad and lightly sclerotized; scutellum yellow; lateral and anterior margins of mesonotum yellow -17
Gonostylus more or less cylindrical, longer than wide and as long or longer than gonocoxite; ventral plate variously shaped, scutellum and margins of mesonotum not yellow ----------18

17. Scutum black with two lance-shaped, silvery-pollinose spots or short vittae ----------S. bivittatum
Scutum greenish-grey with two rectangular silvery-pollinose spots ----------S. griseum

18. Gonostylus about five times longer than wide and without an apical tooth; ventral plate strongly bilobed because of a deep median notch; (distribution apparently restricted to Precambrian Shield) ----------S. longistylatum
Gonostylus less than four times longer than wide, and with an apical tooth; ventral plate without a median notch, but occasionally with a shallow depression; (distribution not restricted to Precambrian Shield) ------19

19. Ventral plate conical or tongue-shaped with a prolonged hyaline tip; base of gonostylus with a prominent, thick, shiny, dorso-medial lobe ----------20
Ventral plate rectangular, tooth or spike-shaped and without a hyaline tip; base of gonostylus generally without a prominent medial, basal lobe, but, if present, then not shiny ----------21

20. Scutum with two prominent white (or black, depending upon angle of illumination) "V"-shaped markings, one in each anterior quarter; ventral plate hairless on posterodorsal surface (Cypress Hills) ----------S. hunteri
Scutum with three white (or black, depending upon angle of illumination) vittae; ventral plate hairy on posterodorsal surface (Cypress Hills) ----------S. piperi

21. Ventral plate exclusive of basal arms, two or three times wider than long ----------22
Ventral plate exclusive of ventral arms, spike or tooth shaped, generally longer than wide ----------25

22. Scutum velvety black but suffused with an ashen pollinosity best seen with horizontal illumination; scutum without prominent, anterior, shining, white spots or bars but with three indistinct vittae; scutum densely covered with golden hairs; gonostylus lacking a prominent medial basal lobe ----------S. meridionale
Scutum velvety black with two prominent, shining, white bars near anterior edge, scutum sparsely clothed with golden or brown hairs; gonostylus with prominent medial basal lobe ----------23

23. Tubercle on base of gonostylus covered with fine hairs ----------S. rugglesi
Tubercle on base of gonostylus covered with stout spines -24

24. Scutum velvety black with a broad silvery-pollinose bar extending posteriorly from each anterior corner to meet in center of scutum ----------S. transiens
Scutum velvety black with a silvery-pollinose spot in each anterior corner, not meeting in center of disc ----------S. tuberosum

25. Ventral plate "Y"-shaped with a spike-shaped median keel when seen in ventral view; tip of ventral plate not prominently hairy ----------26
Ventral plate with a broader, tooth-shaped median keel (except for decorum) which is narrow but prominently hairy ----------28

26. Hind basitarsus with distal half dark, proximal half pale; fore coxa pale (entire province) ----------S. arcticum
Hind basitarsus mostly or entirely dark; fore coxa dark --27

27. Femora, tibia, and basitarsus of hind leg each with proximal one-fifth pale, remainder dark; (northern Saskatchewan) ----------S. corbis
Entire hind leg dark; (northwestern Saskatchewan) ----------S. malyshevi

28. Arms of ventral plate each with a prominent lateral projection; gonostylus lacking hairy lobe at base; posterior quarter of scutum with only a few weak hairs ----------S. luggeri
Arms of ventral plate lacking prominent lateral projections; base of gonostylus generally with a hairy or spiny lobe on the medial surface; posterior quarter of scutum with strong erect hairs ----------29

29. Ventral plate in dorsal view relatively broad with the approximate outline of a molar tooth ----------S. venustum
Ventral plate laterally compressed into a narrow keel ----30

30. Scutum with two large grey-brown pollinose areas occupying most of anterior edge when viewed anteriorly under anterodorsal illumination ----------S. decorum
Scutum velvety black with two white bars or triangular spots extending posteromedially from anterior edge when viewed anteriorly ----------S. verecundum

APPENDIX C

GLOSSARY

Abdominal fringe--a fringe of long hairs arising dorsally and laterally from the basal scale of the first abdominal segments.

Anal lobes--a pair of large lobes at the posterior end of a female black fly. (Figs. 12, 13).

Antennae--a pair of stout sensory appendages on the face, consisting of eight or nine segments (excluding the two basal segments). (Figs. 6, 7).

Basal cell--a small "window" in the base of the wing of some species. (Fig. 1).

Basitarsus--the long proximal segment of the tarsus. (Figs. 2, 3, 8-11).

Calcipala--a rounded lobe at the distal end of the hind basitarsus. (Figs. 2, 3, 8-11).

Cercus--the rounded terminal segment attached to the anal lobe of the female. (Figs. 12-13).

Costa--the strong vein forming the leading edge of the wing. (Fig. 1).

Coxa--the first (proximal) segment of each leg. (Figs. 8-11).

Endoparameral spines--internal sclerotized rods in the male terminalia. (Fig. 4).

Femur--the third segment of the leg. (Figs. 8-11).

Frons--the face plate above and between the antennae. (Figs. 6-7).

Gonocoxite--the proximal segment of the male clasper at the posterior end of the abdomen. (Fig. 4).

Gonostylus--the terminal segment of the male clasper. (Figs. 4, 5).

Hypogynial valves (=ovipositor flaps)--paired ventral plates (sternites) of the tenth abdominal segment. (Figs. 12, 13).

Integument--exoskeleton or external covering.

Katepisternum--a small ventral plate of the integument of the mesonotum.

Mesonotum--the dorsal plates of the second (middle) thoracic segment.

Pedisulcus--a dorsal notch on the second tarsal segment of the third leg. (Figs. 2, 3, 8-11).

Pleural tuft--a tuft of hairs on the integumental plate above the base of the second leg. (Fig. 5).

Pollinose--appearing as if thinly dusted.

Postnotum--the prominent dorsal lobe behind the scutellum. (Fig. 5).

Radial sector--the posterior branch of the radius (third major vein of the wing). (Fig. 1).

Respiratory organs--two tufts of filaments, one at each anterior corner of the pupa. (Figs. 14-27).

Scutellum--a rounded, triangular dorsal lobe immediately posterior to the scutum. (Fig. 5).

Scutum--the dorsal plate of the mesothorax, forming the major part of the "humped back" of a black fly adult. (Fig. 5).

Stem vein--the short, stout wing vein forming the basal portion of the radius. (Fig. 1).

Subcosta--a short weak wing vein between the stem vein and the costa. (Fig. 1).

Tarsus--the five terminal segments of the leg. (Figs. 2, 3, 8-11).

Tarsal claws--a pair of stout claws attached to the fifth tarsal segment of each leg. (Figs. 8-11).

Tergite--dorsal plate of each segment of the thorax and abdomen.

Tibia--the fourth segment of the leg, to which the five tarsal segments are attached. (Figs. 8-11).

Trochanter--the second segment of the leg. (Figs. 8-11).

Vein R--the third and strongest wing vein, branches of which extend to the tip. (Fig. 1).

Ventral plate--the large strongly sclerotized plate between the gonocoxites at the posterior end of the male abdomen. (Fig. 4).

Vittae--longitudinal stripes.

APPENDIX D

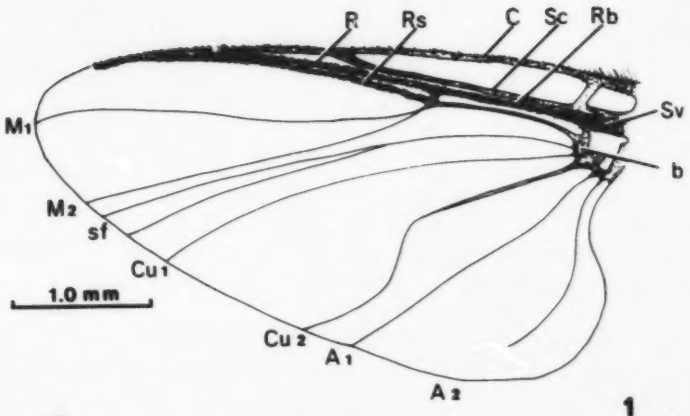
FIGURES

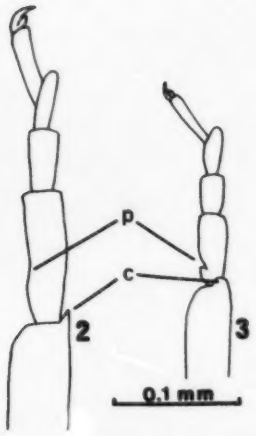
Figure 1. Wing of Ectemnia taeniatifrons (Enderlein), showing: basal cell (b); stem vein (Sv); basal section of radius (Rb); subcosta (Sc); costa (C); radial sector (Rs); radius (R); media (M_1, M_2); submedial false vein (sf); cubitus, anterior branches (Cu_1, Cu_2); anal (A_1, A_2).

Figure 2. Tarsomeres of E. taeniatifrons, showing: pointed calcipala (c) on the basitarsus, and shallow pedisulcus (p) on the second tarsomere.

Figure 3. Tarsomeres of Simulium duplex Shewell and Fredeen, showing: rounded calcipala (c) and deep pedisulcus (p).

Figure 4. Terminalia of male Metacnephia saskatchewana (Shewell and Fredeen): Endoparameral spines (p), ventral plate (v), ventral plate arm (a), gonocoxite (gc), gonostylus (gs), and terminal spine (s).


R
Rs
C
Sc
Rb
Sv
b
M1
M2
sf
Cu1
1.0 mm
Cu2
A1
A2
1


p
c
2
3
0.1 mm

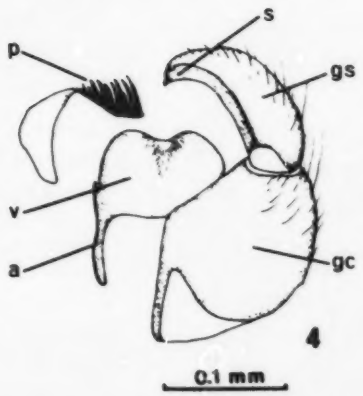
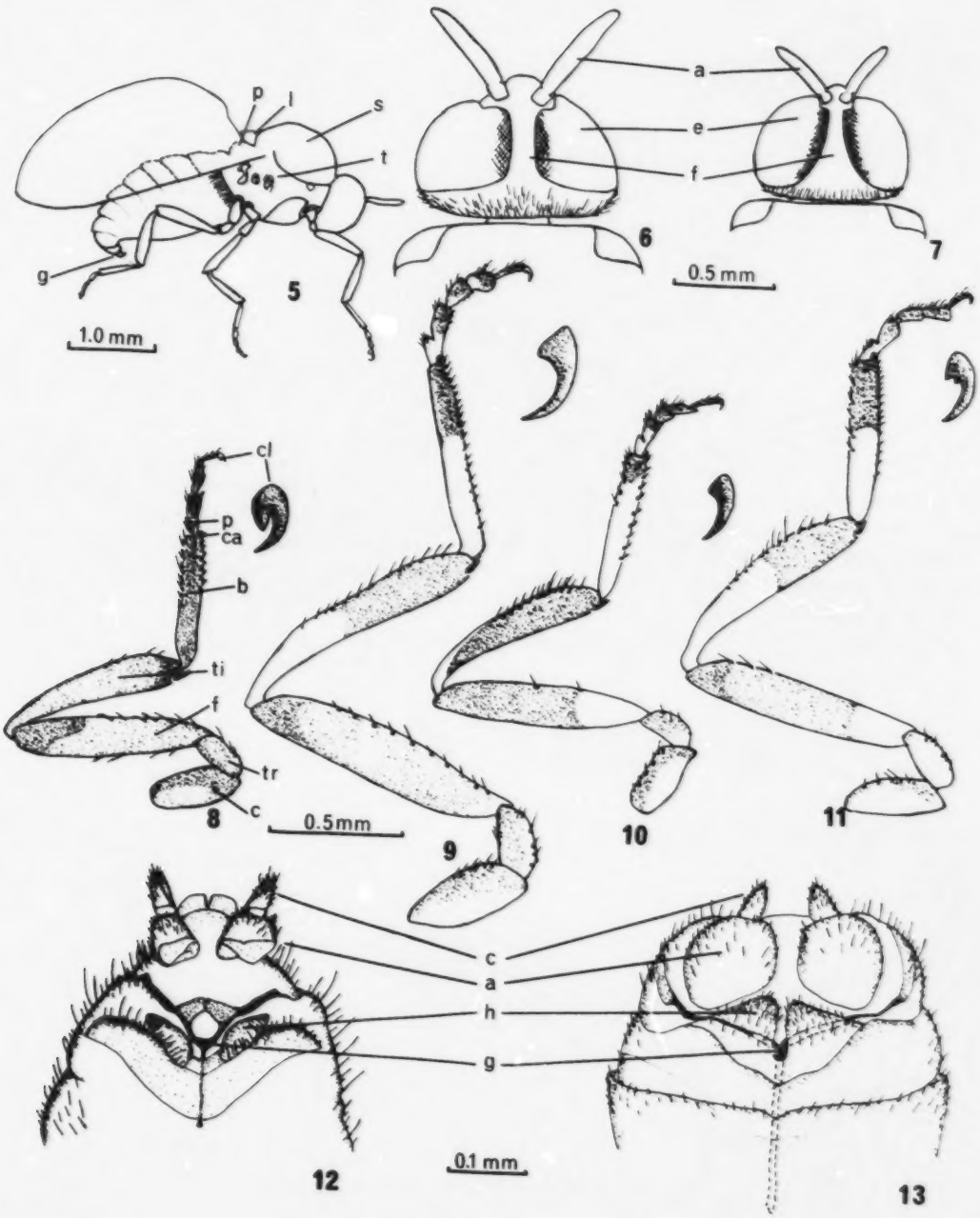

s
p
gs
v
a
gc
4
0.1 mm

Figure 5. Male of S. duplex: pleural tuft (t), scutum (s), scutellum (l), postnotum (p), gonostylus (g).

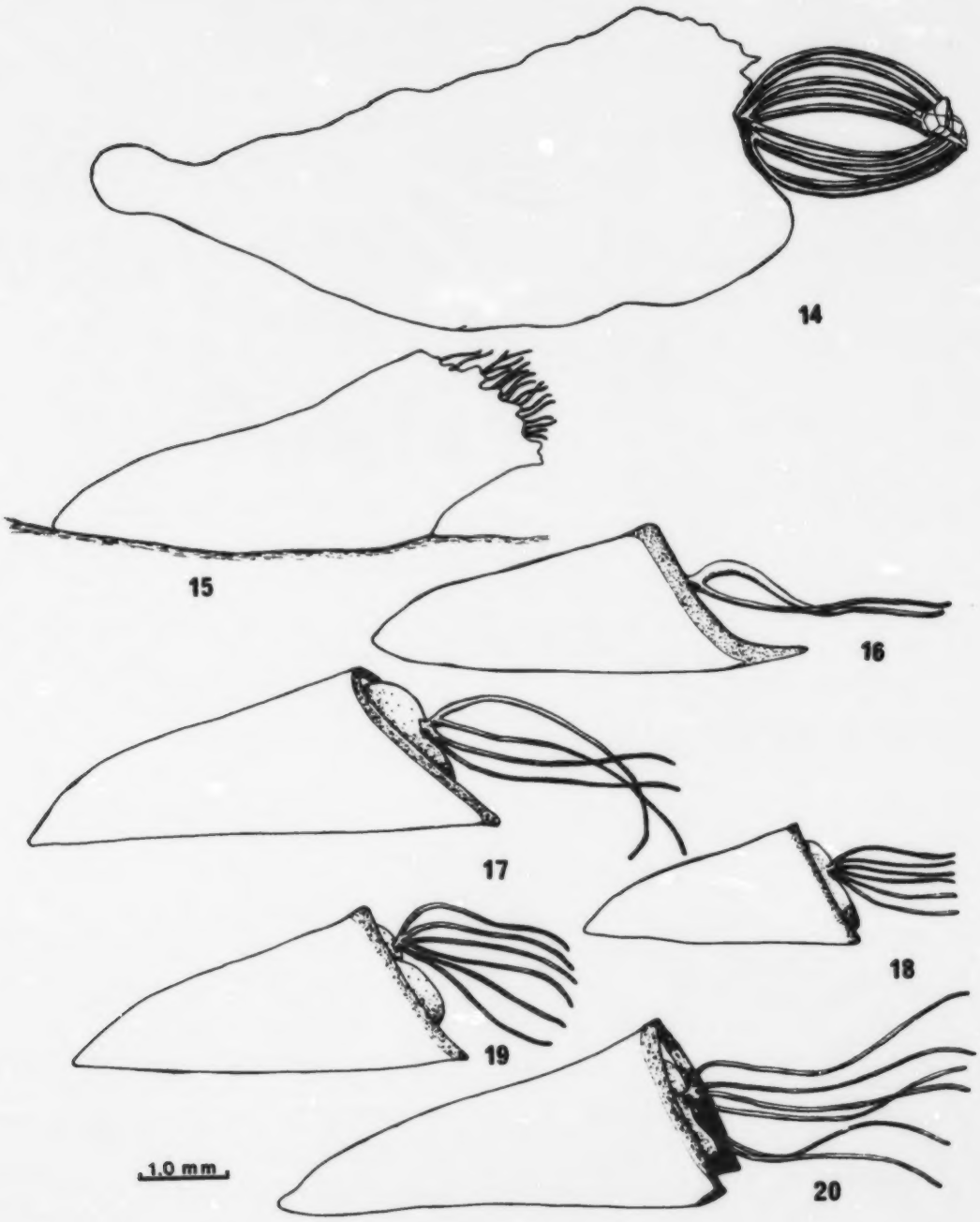
Figures 6 and 7. Head, female, dorsal aspect, showing: antenna (a), eye (e), frons (f), of: 6, E. taeniatifrons and 7, M. saskatchewana.

Figures 8 - 11. Third leg of female Simulium: claw (cl), pedisulcus on second tarsal segment (p), calcipala (ca), basitarsus (b), tibia (ti), femur (f), trochanter (tr), coxa (c) of: 8, S. meridionale Riley, 9, S. vittatum Zetterstedt, 10, S. luggeri Nicholson and Mickel, 11, and S. arcticum Malloch.

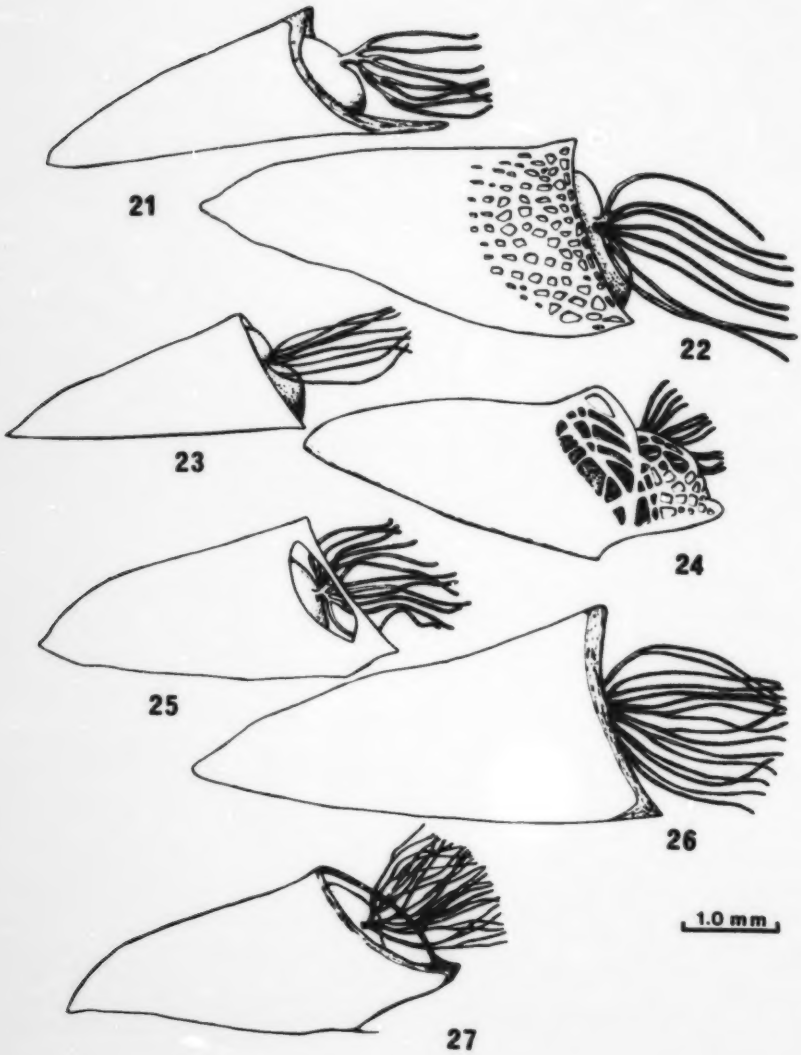
Figures 12 and 13. Terminalia of female Simulium, ventral view: cercus (c), anal lobe (a), hypogynial valve (h), genital fork (g) of: 12, S. luggeri and 13, S. arcticum.


p
l
s
t
g
5
1.0 mm
a
e
f
6
7
0.5 mm
cl
p
ca
b
ti
f
tr
c
8
0.5mm
9
10
11
c
a
h
g
12
0.1 mm
13

Figures 14 - 20. Cocoon and one set of respiratory filaments of pupa, of: 14, Ectemnia taeniatifrons (Enderlein), 15, Metacnephia saskatchewana (Shewell and Fredeen), 16, Simulium duplex Shewell and Fredeen, 17, S. euryadminiculum Davies, 18, S. tuberosum (Lundstrom), 19, S. venustum Say, 20, S. verecundum Stone and Jamnback.


14
15
16
17
18
19
20
1.0 mm

Figures 21 - 27. Cocoon and one set of respiratory filaments of pupa, of: 21, S. rugglesi Nicholson and Mickel, 22, S. decorum Walker, 23, S. griseum Coquillett and S. bivittatum Malloch, 24, S. arcticum Malloch, 25, S. luggeri Nicholson and Mickel, 26, S. vittatum Zetterstedt, 27, S. meridionale Riley.


21
22
23
24
25
26
27
1.0 mm

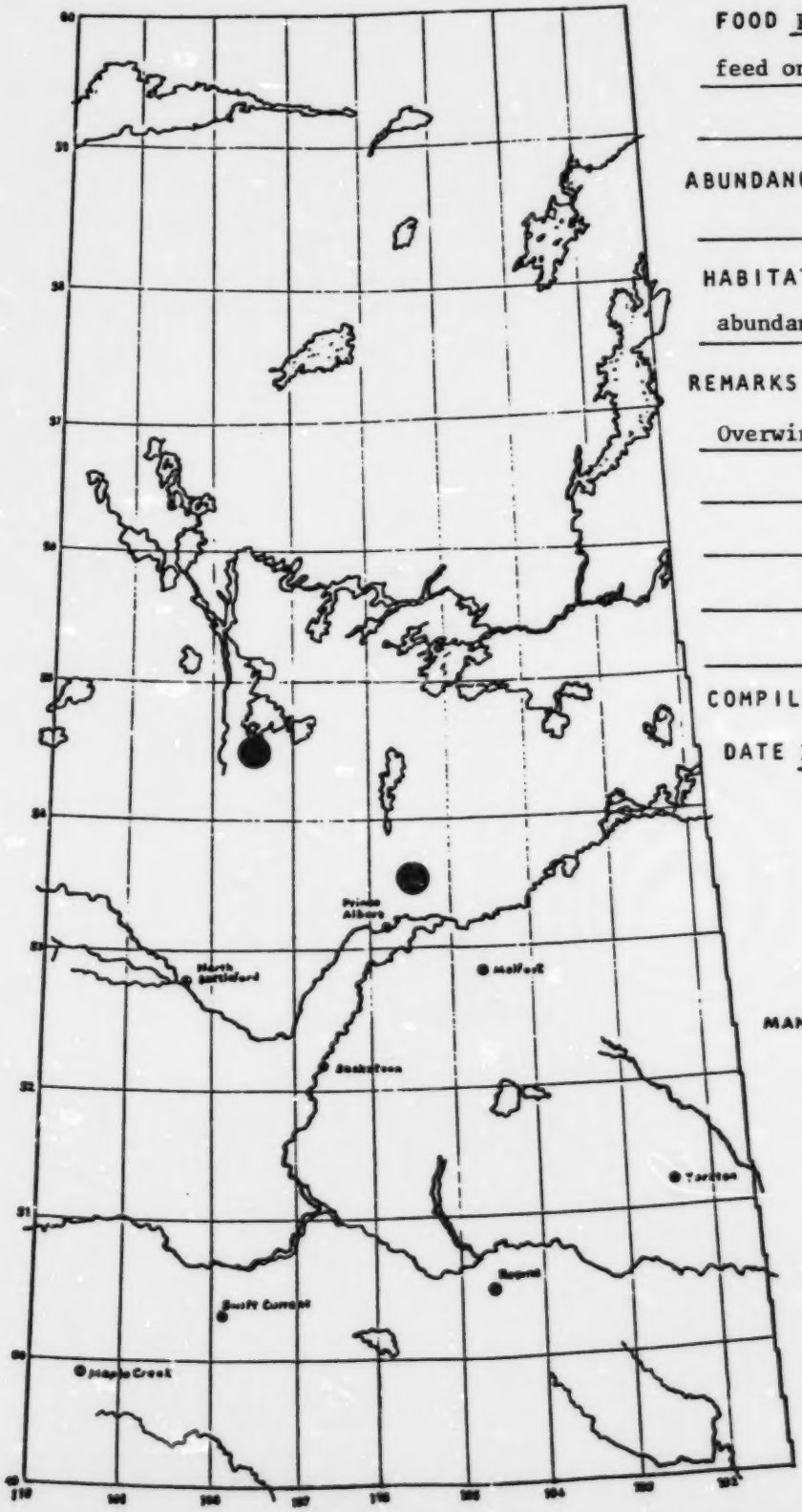
APPENDIX E

DISTRIBUTION MAPS

SPECIES *Prosimulium (Parahelodon) decemarticulatum* (Twinn) Map 1

COMMON NAME _____

SYNONOMY _____



FOOD Reported to feed on birds.

ABUNDANCE Rare.

HABITAT Small abundant streams.

REMARKS Univoltine. Overwinters as larvae.

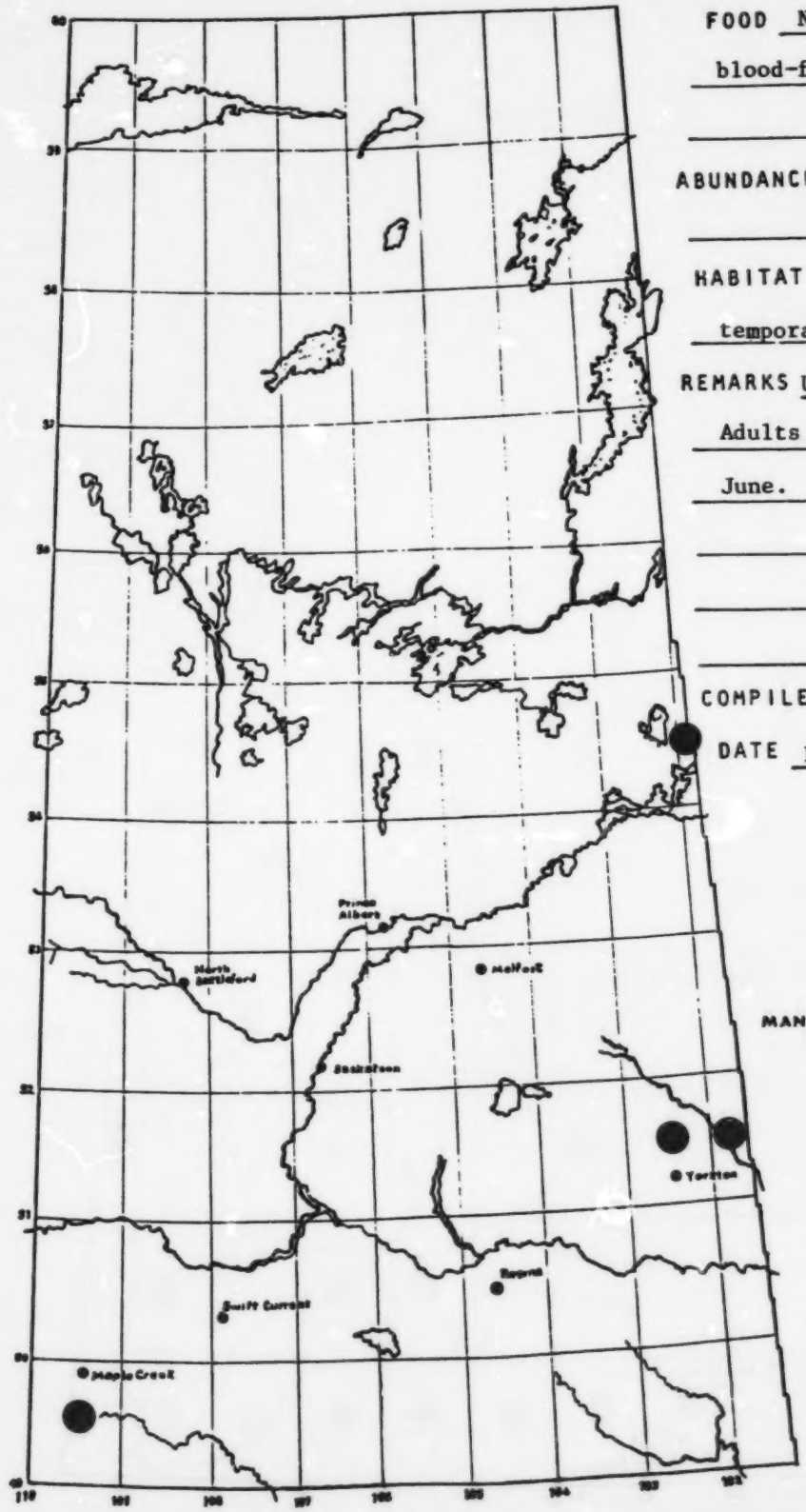
COMPILER F.J.H. Fredeen

DATE December 1981

SPECIES *Prosimulium (Parahelodon) gibsoni* (Twinn) Map 2

COMMON NAME

SYNONOMY



FOOD Not known to blood-feed.

ABUNDANCE Rare.

HABITAT Shallow temporary streams.

REMARKS Univoltine. Adults emerge about June.

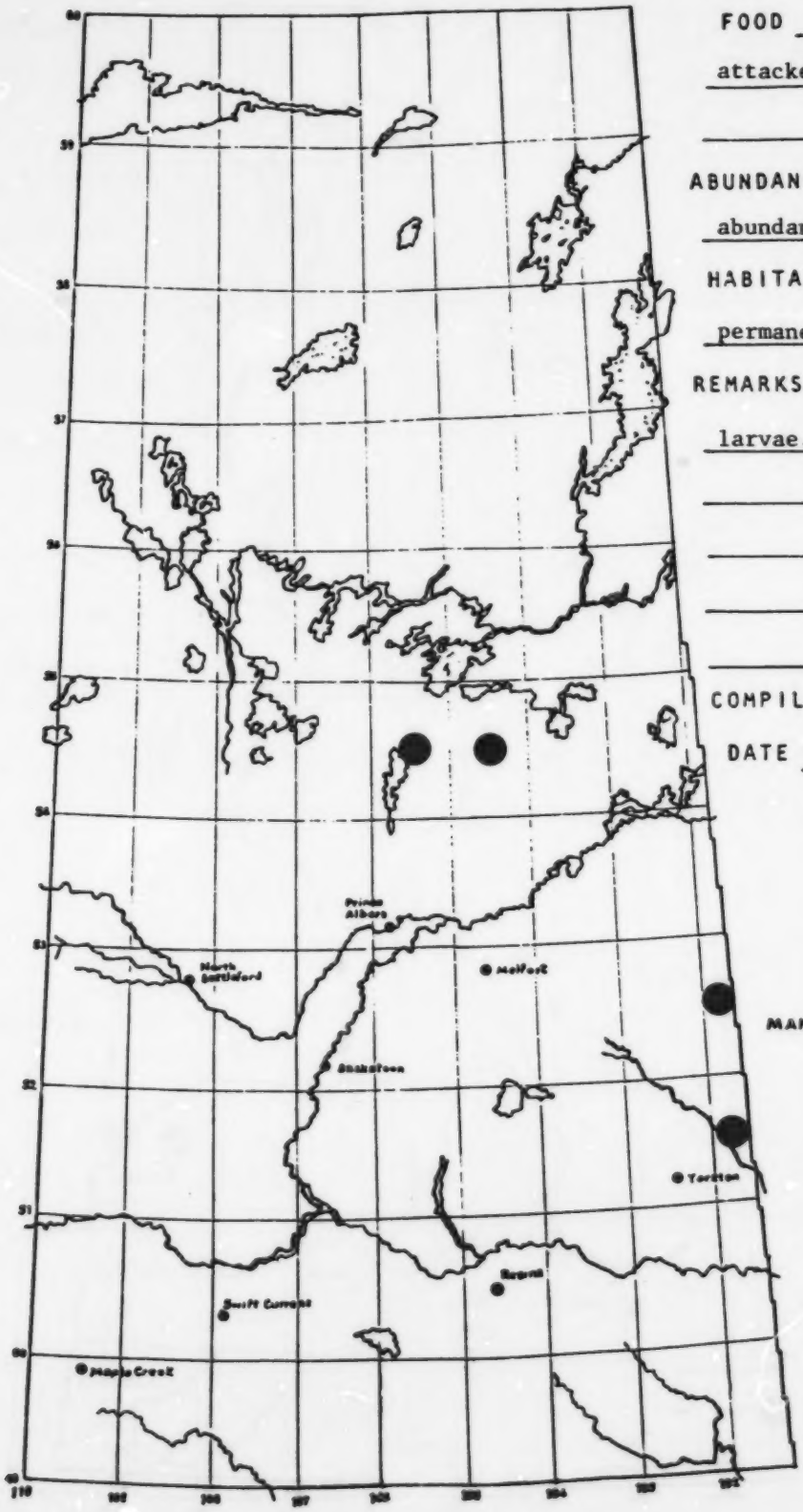
COMPILER F.J.H. Fredeen

DATE December 1981

SPECIES *Prosimulium (Prosimulium) fuscum* Syme and Davies Map 3

COMMON NAME _____

SYNONOMY _____



FOOD Mammals are attacked for blood.

ABUNDANCE Locally abundant.

HABITAT Small permanent streams.

REMARKS Overwinters as larvae. Univoltine.

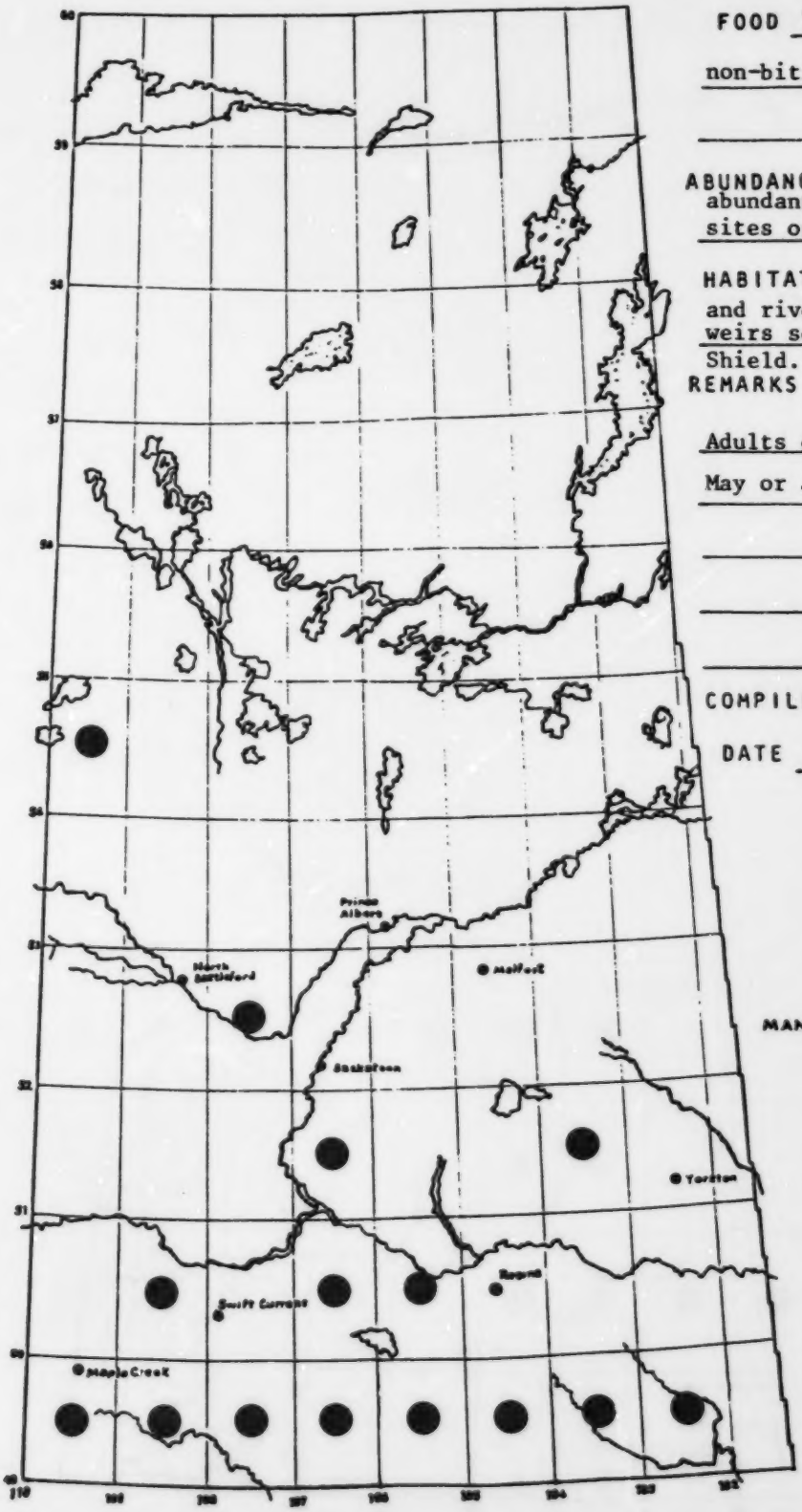
COMPILER F.J.H. Fredeen

DATE December 1981

SPECIES *Cnephia dacotensis* (Dyar and Shannon) Map 4

COMMON NAME

SYNONOMY



FOOD The adults are non-biting.

ABUNDANCE Sometimes abundant at immediate sites of emergence.

HABITAT Small streams and rivers, especially at weirs south of Precambrian Shield.

REMARKS Univoltine. Adults emerge in late May or June.

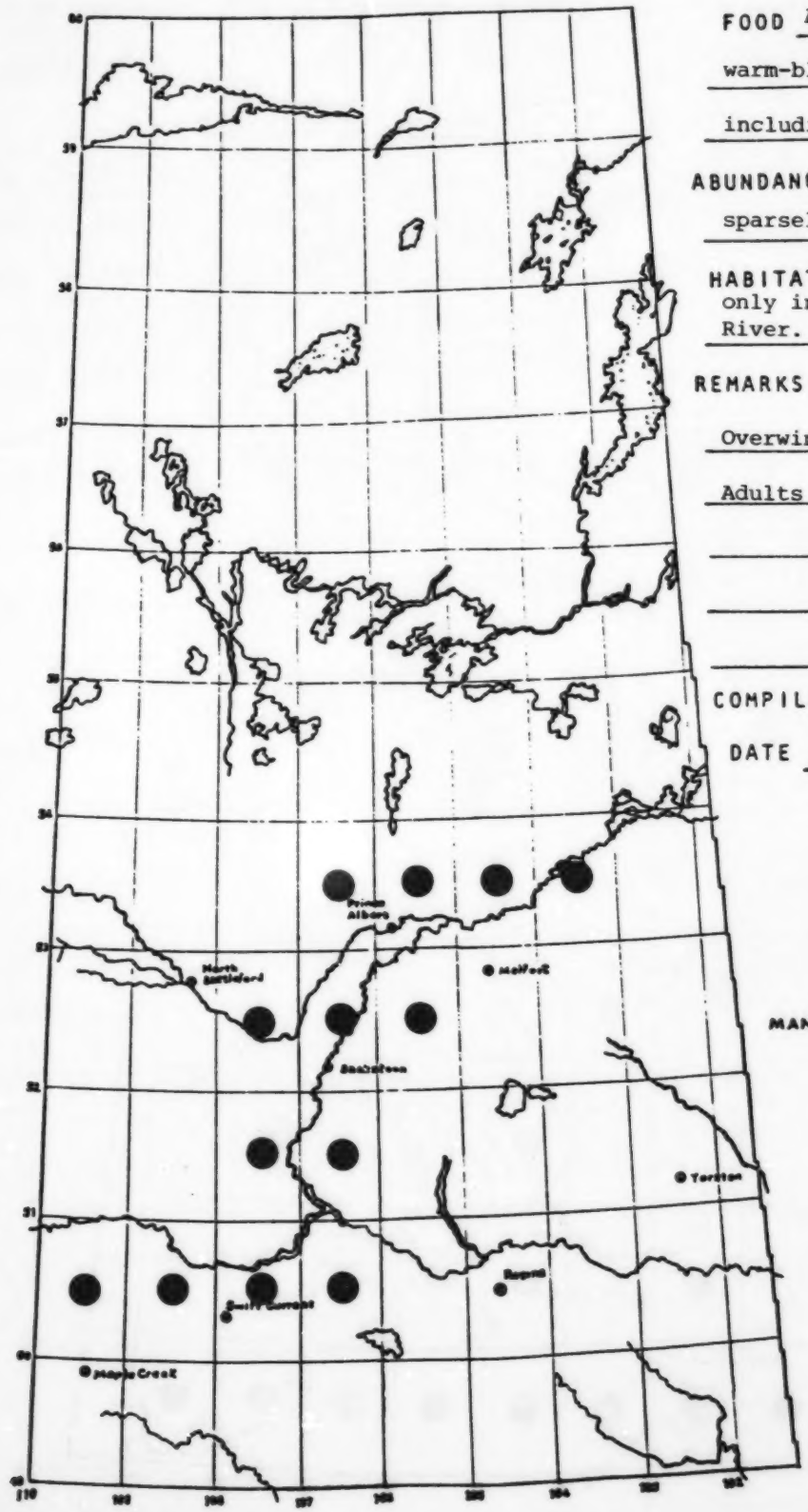
COMPILER F.J.H. Fredeen

DATE December 1981

SPECIES *Ectemnia taeniatifrons* (Enderlein) Map 5

COMMON NAME

SYNONOMY



FOOD Adults attack warm-blooded mammals, including man.

ABUNDANCE Uncommon and sparsely distributed.

HABITAT Larvae found only in Saskatchewan River.

REMARKS Univoltine. Overwinters as larvae. Adults emerge in May.

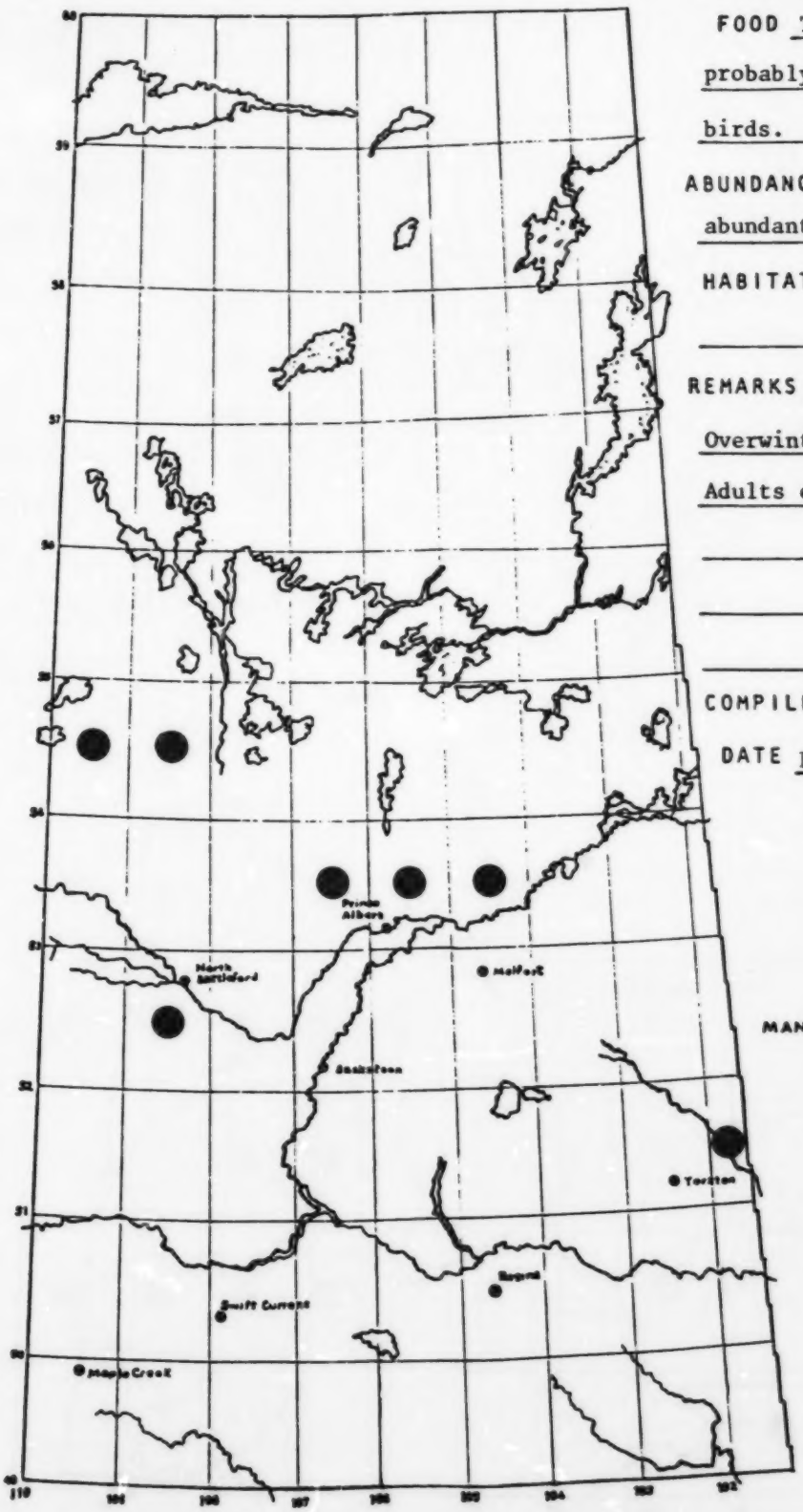
COMPILER F.J.H. Fredeen

DATE December 1981

SPECIES *Metacnephia saskatchewana* (Shewell and Fredeen) Map 6

COMMON NAME _____

SYNONOMY _____



FOOD The adults probably feed on birds.

ABUNDANCE Locally abundant.

HABITAT Small rivers.

REMARKS Univoltine. Overwinters as larvae. Adults emerge in May.

COMPILER F.J.H. Fredeen

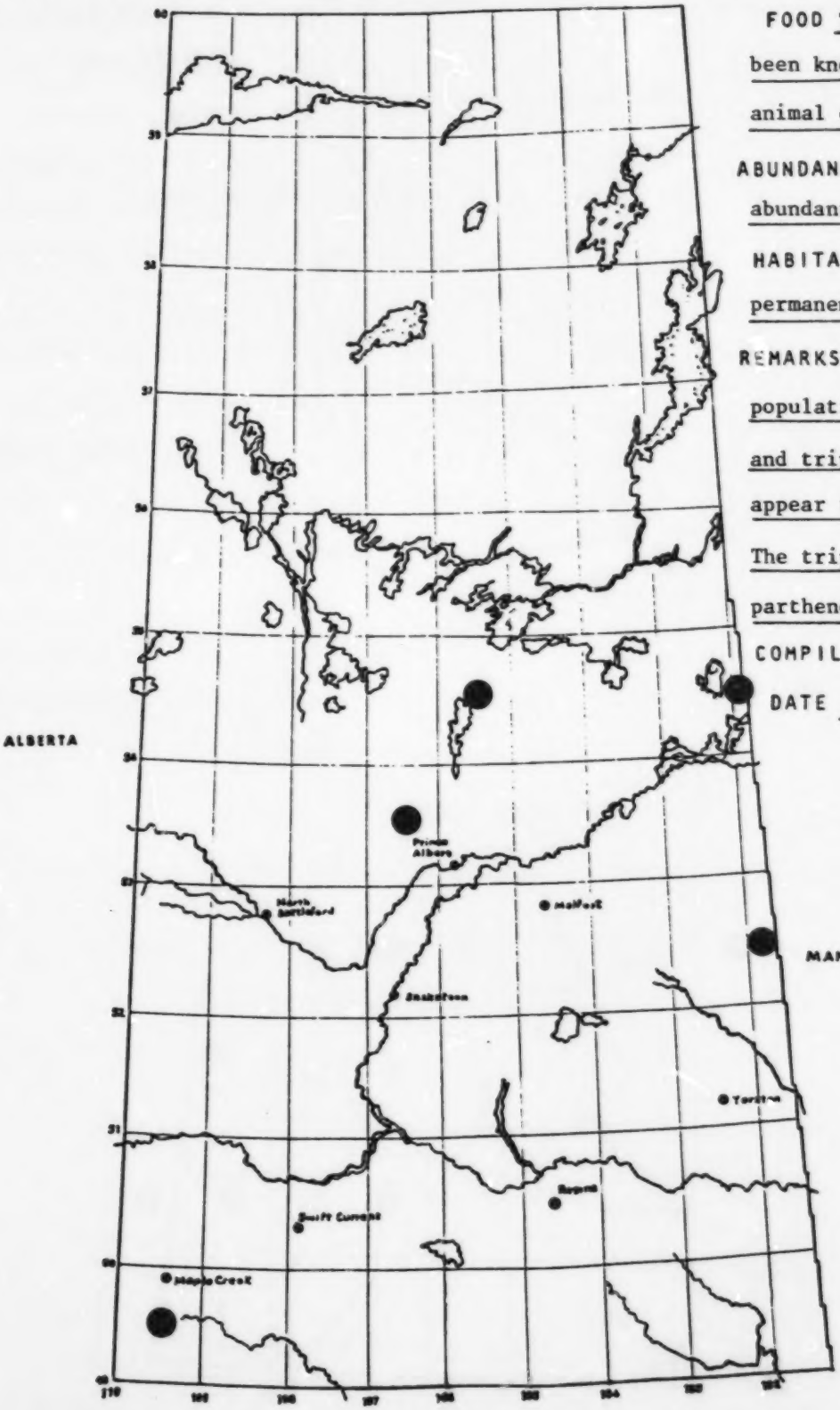
DATE December 1981

SPECIES *Stegopterna mutata* (Malloch)

Map 7

COMMON NAME

SYNONOMY



FOOD The females have been known to enter animal ears for blood.

ABUNDANCE Locally abundant in late spring.

HABITAT Small permanent streams.

REMARKS Occurs as mixed populations of diploid and triploid forms. Both appear to be univoltine. The triploid form is parthenogenetic.

COMPILER F.J.H. Fredeen

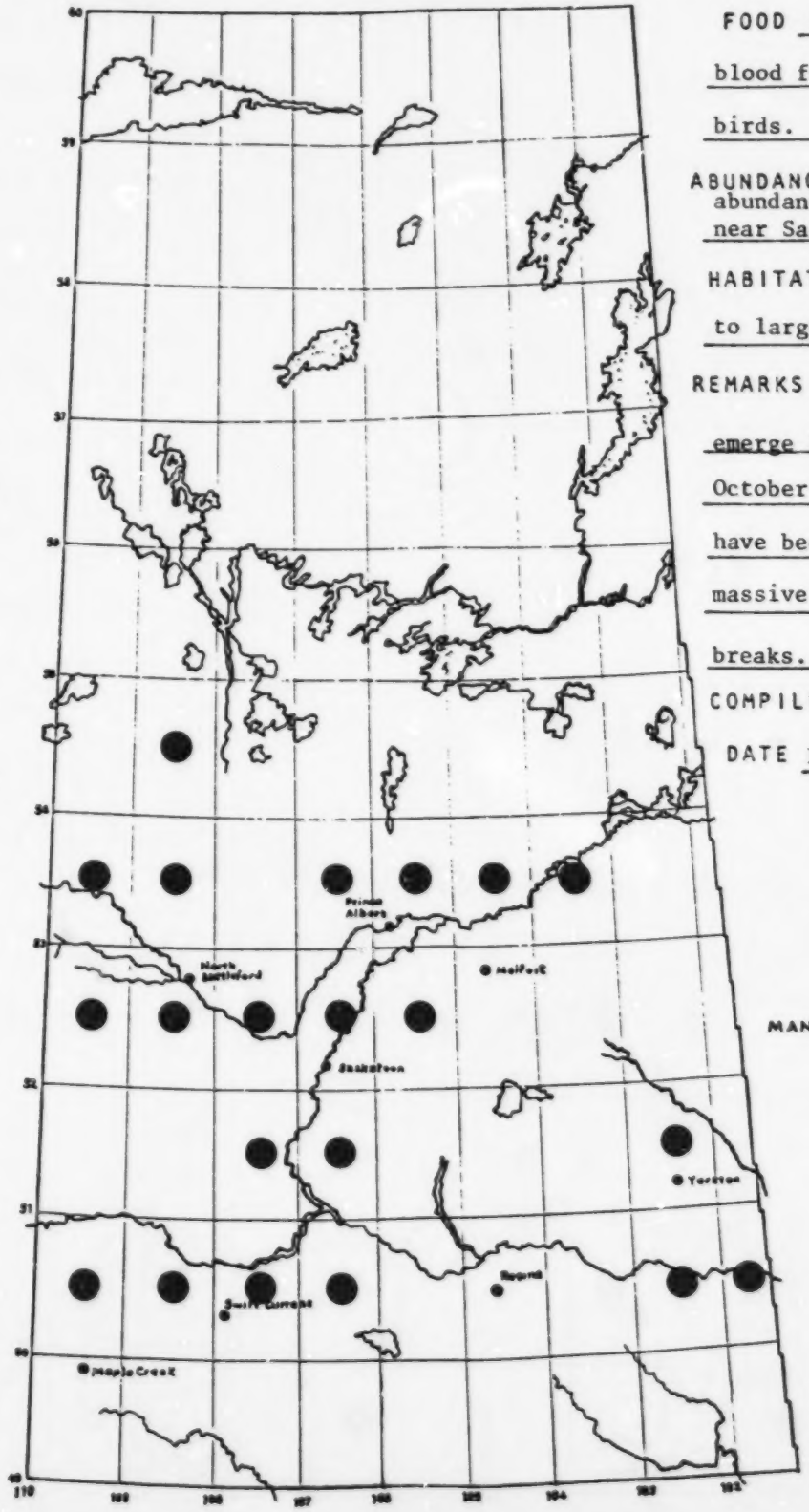
DATE December 1981

SPECIES *Simulium (Byssodon) meridionale* Riley

Map 8

COMMON NAME

SYNONOMY



FOOD The females take blood from mammals and birds.

ABUNDANCE Locally abundant, especially near Saskatchewan River.

HABITAT Small streams to large rivers.

REMARKS The adults emerge late May to October. Domestic birds have been killed during massive but brief out-breaks.

COMPILER F.J.H. Fredeen

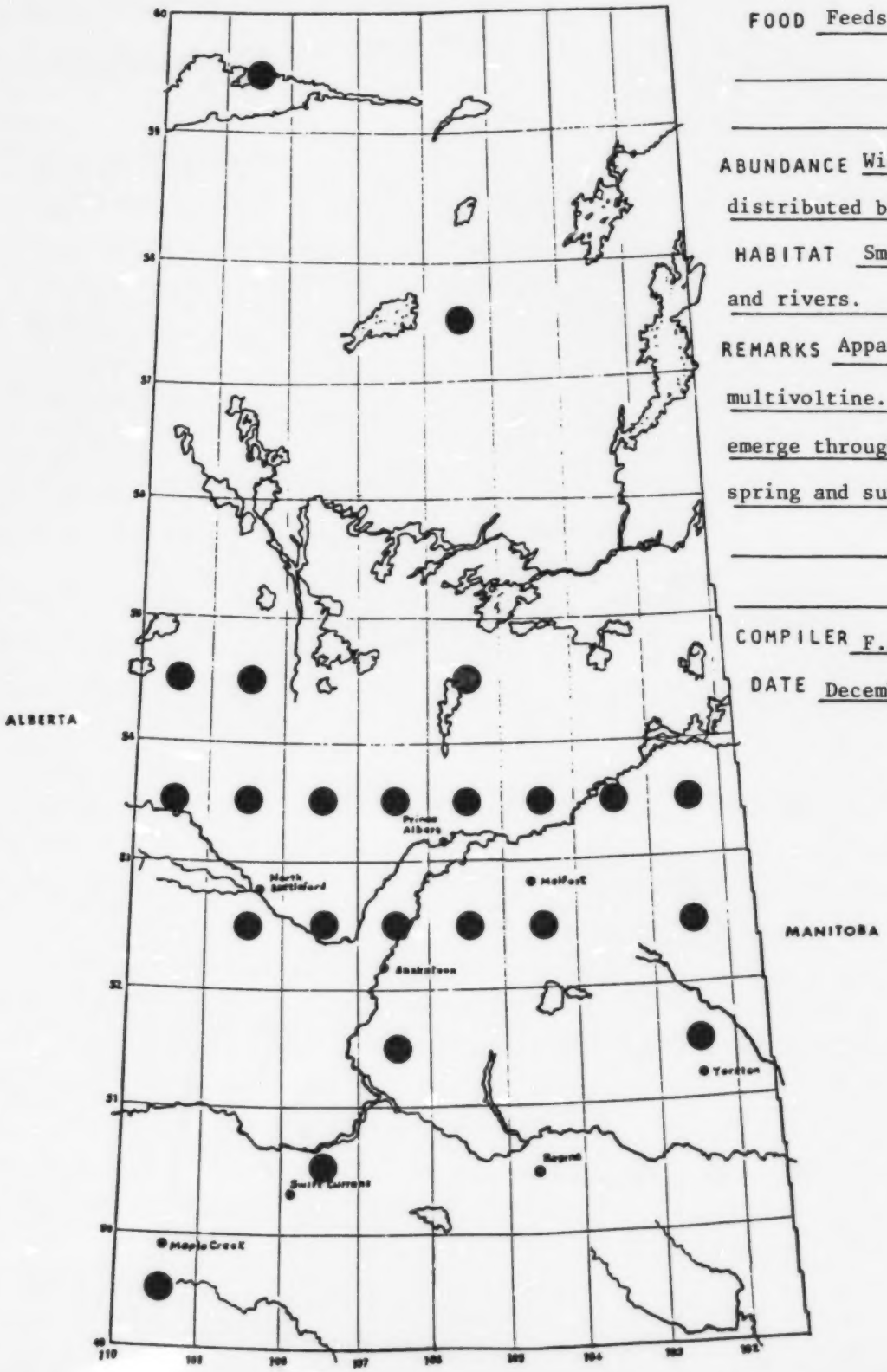
DATE December 1981

SPECIES *Simulium (Eusimulium) aureum* Fries

Map 9

COMMON NAME

SYNONOMY



FOOD Feeds on birds.

ABUNDANCE Widely distributed but scarce.

HABITAT Small streams and rivers.

REMARKS Apparently multivoltine. Adults emerge throughout late spring and summer.

COMPILER F.J.H. Fredeen

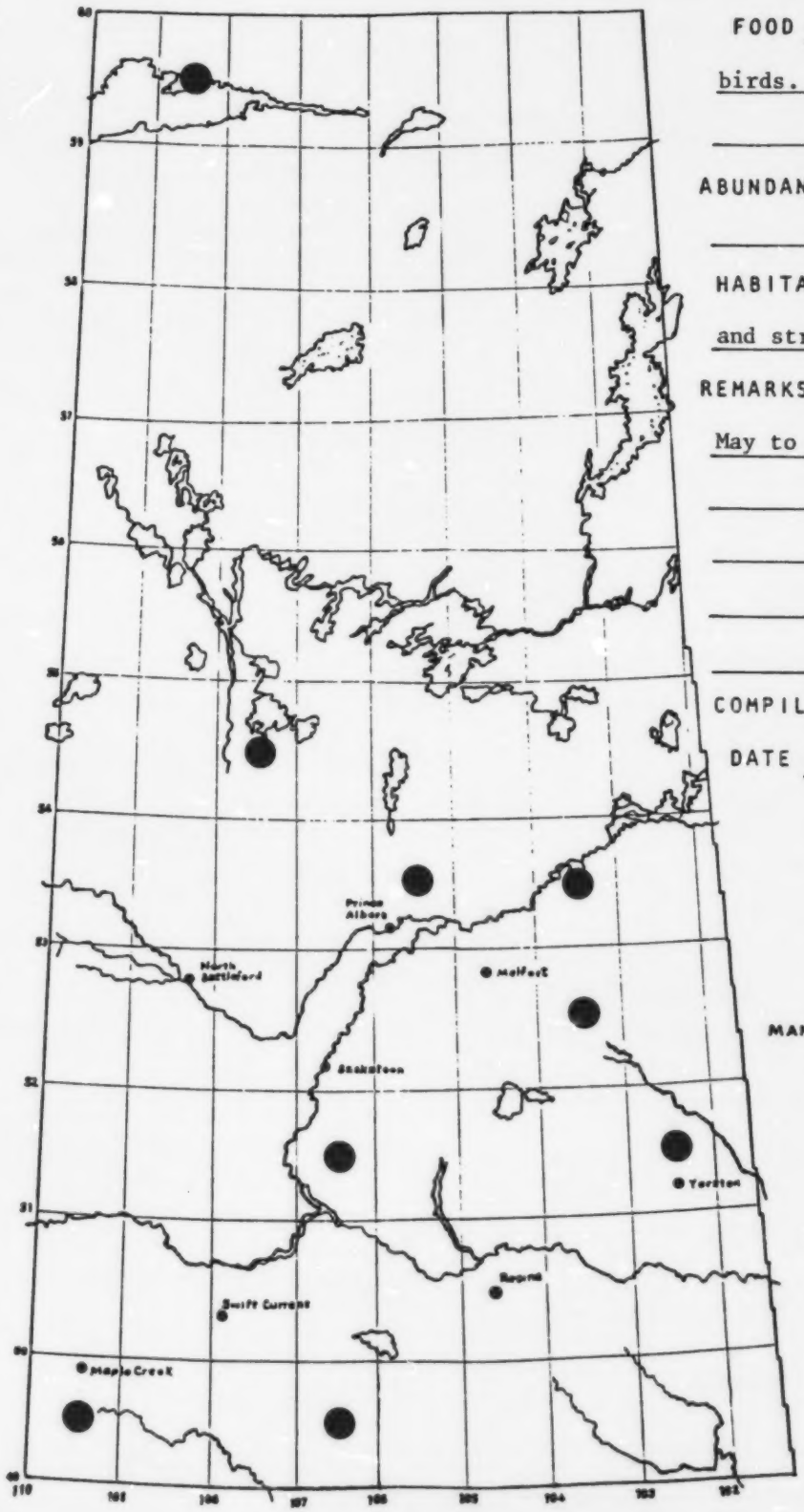
DATE December 1981

SPECIES *Simulium (Eusimulium) croxtoni* Nicholson and Mickel

Map 10

COMMON NAME

SYNONOMY



FOOD Adults feed on birds.

ABUNDANCE Rare.

HABITAT Small rivers and streams.

REMARKS Adults emerge May to July.

COMPILER F.J.H. Fredeen

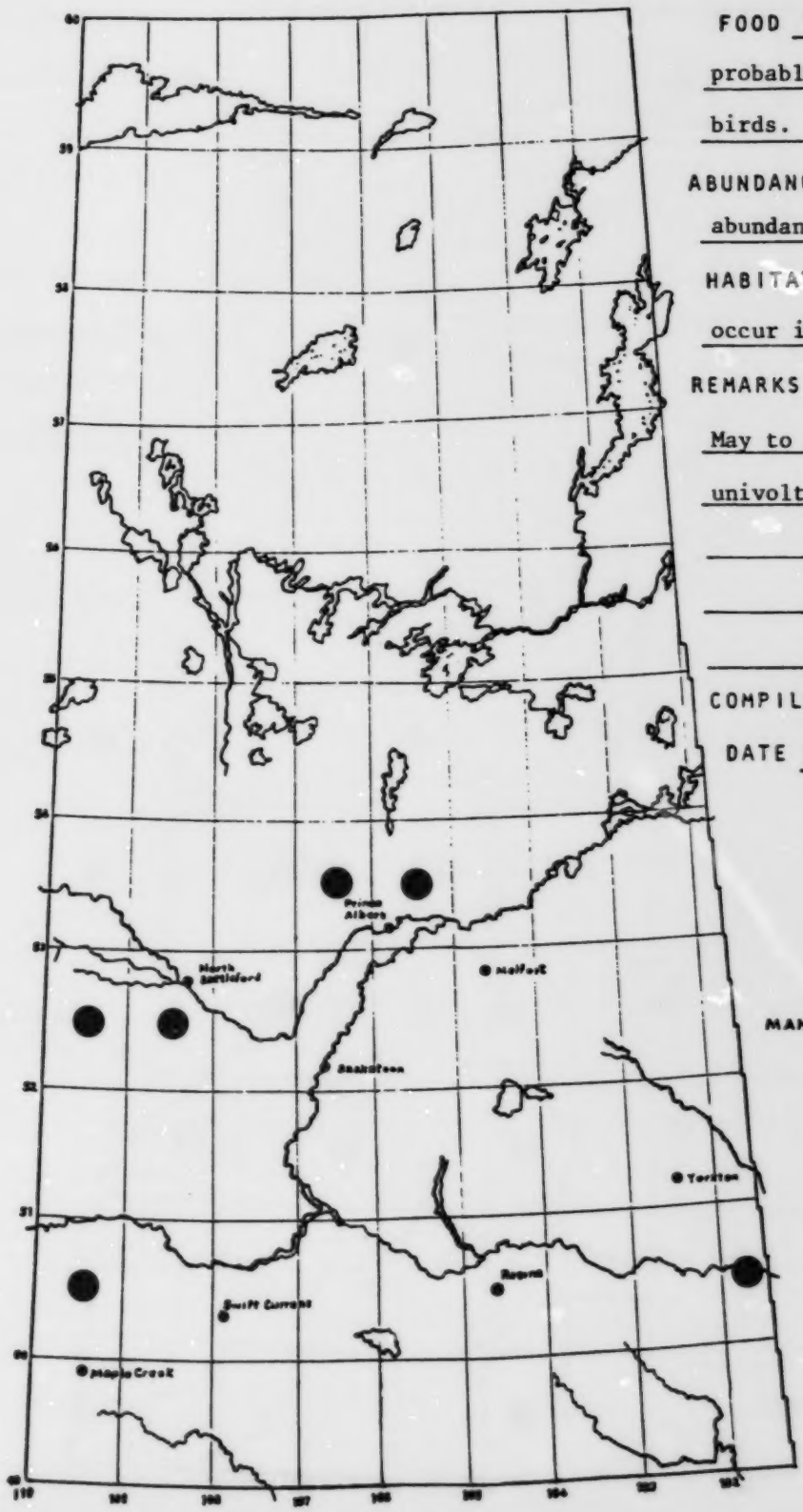
DATE December 1981

SPECIES *Simulium (Eusimulium) duplex* Shewell and Fredeen

Map 11

COMMON NAME

SYNONOMY



FOOD The adults probably feed on birds.

ABUNDANCE Locally abundant.

HABITAT The larvae occur in small rivers.

REMARKS Adults emerge May to June. Probably univoltine.

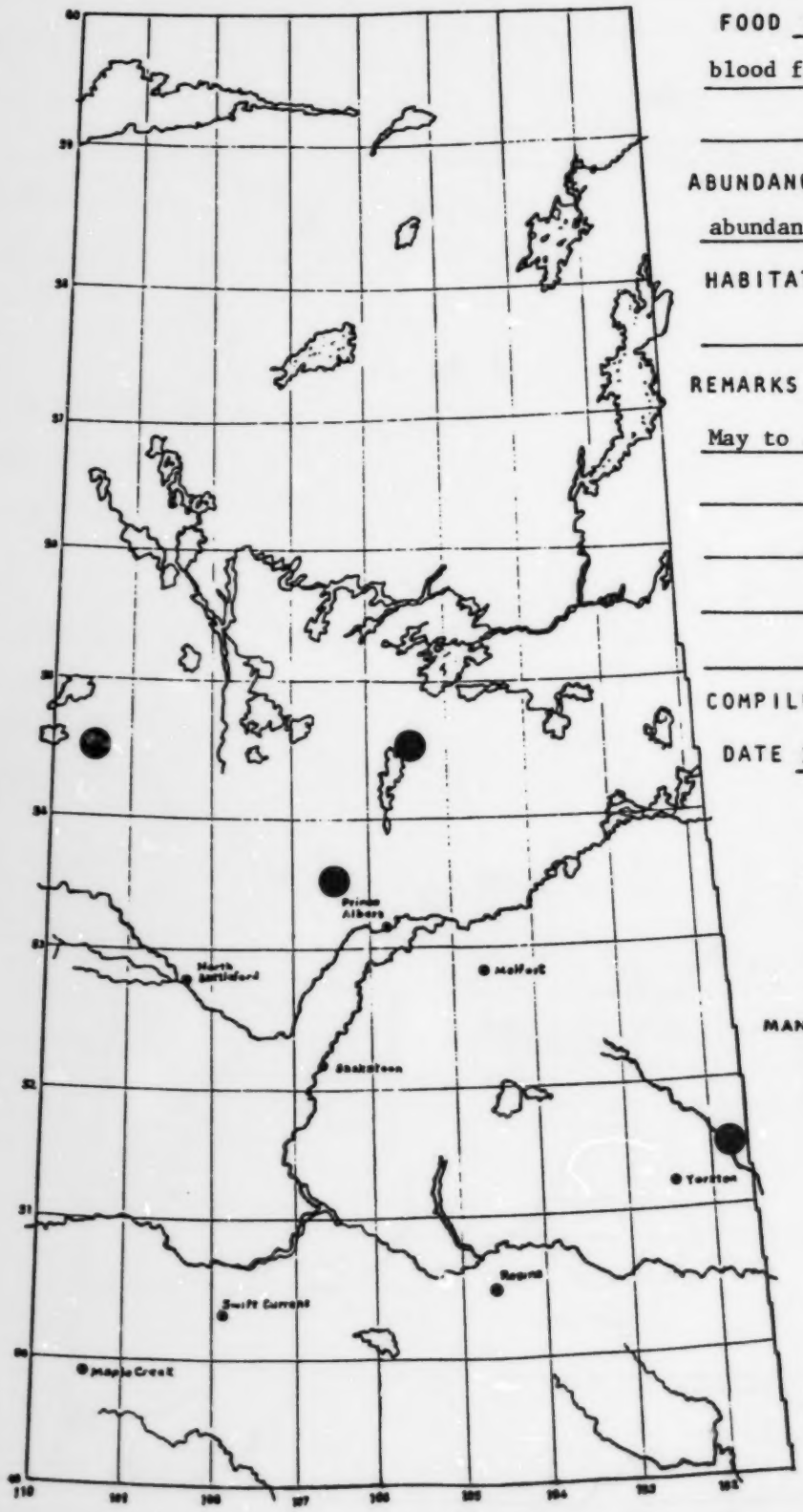
COMPILER F.J.H. Fredeen

DATE December 1981

SPECIES *Simulium (Eusimulium) euryadminiculum* Davies Map 12

COMMON NAME

SYNONOMY



FOOD The females take blood from birds.

ABUNDANCE Locally abundant.

HABITAT Small rivers.

REMARKS Adults emerge May to June.

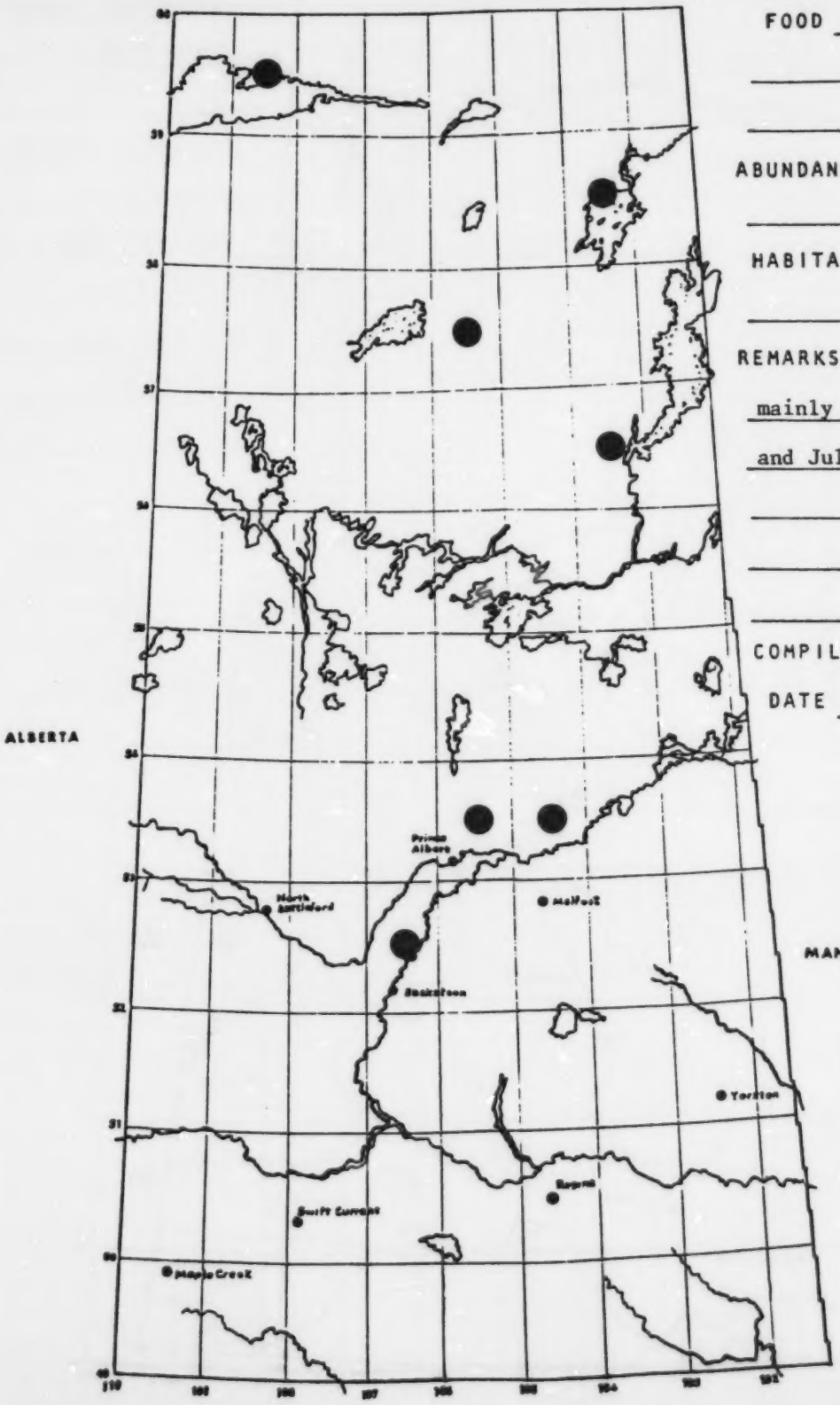
COMPILER F.J.H. Fredeen

DATE December 1981

SPECIES *Simulium (Eusimulium) furculatum* (Shewell) Map 13

COMMON NAME

SYNONOMY



FOOD Unknown.

ABUNDANCE Scarce.

HABITAT Small streams.

REMARKS Adults emerge mainly during June and July.

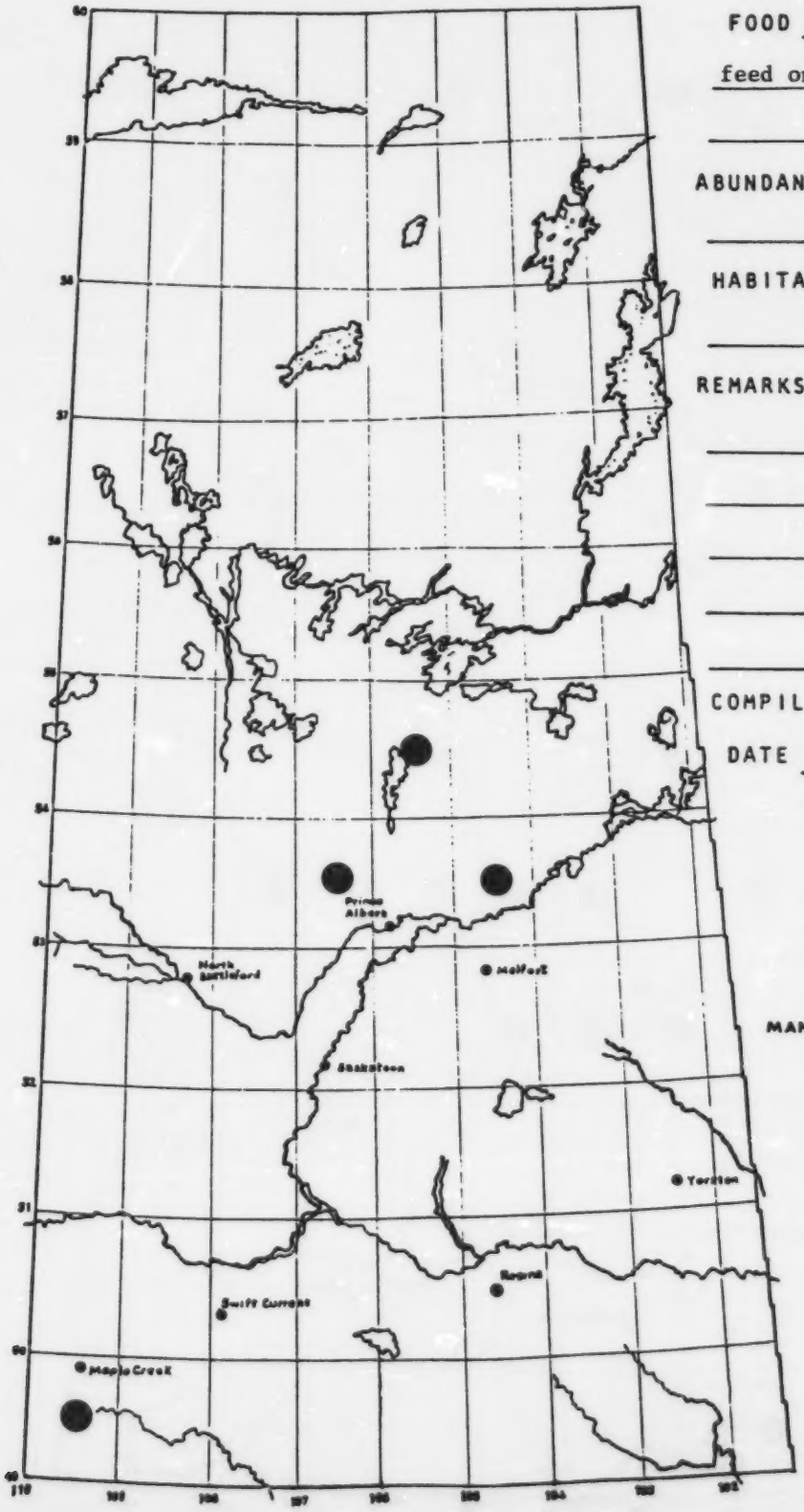
COMPILER F.J.H. Fredeen

DATE December 1981

SPECIES *Simulium (Eusimulium) pugetense* (Dyar and Shannon) Map 14

COMMON NAME _____

SYNONOMY _____



FOOD The females may feed on birds.

ABUNDANCE Rare.

HABITAT Small rivers.

REMARKS Little known.

COMPILER F.J.H. Fredeen

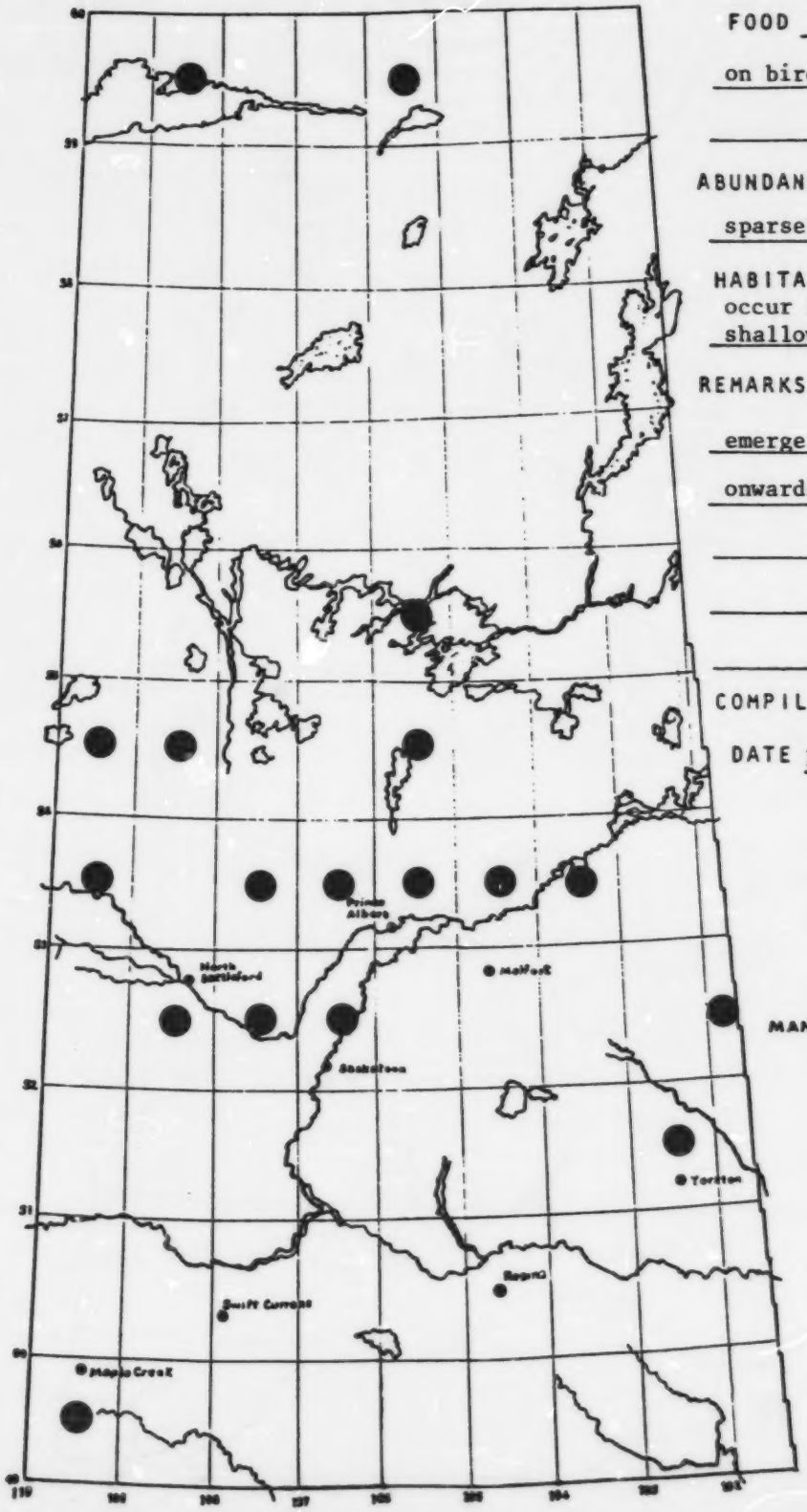
DATE December 1981

SPECIES *Simulium (Eusimulium) vernum* Macquart

Map 15

COMMON NAME

SYNONOMY



FOOD The females feed on birds.

ABUNDANCE Widely but sparsely distributed.

HABITAT The larvae occur in streams or shallow rivers.

REMARKS The adults emerge from May onwards.

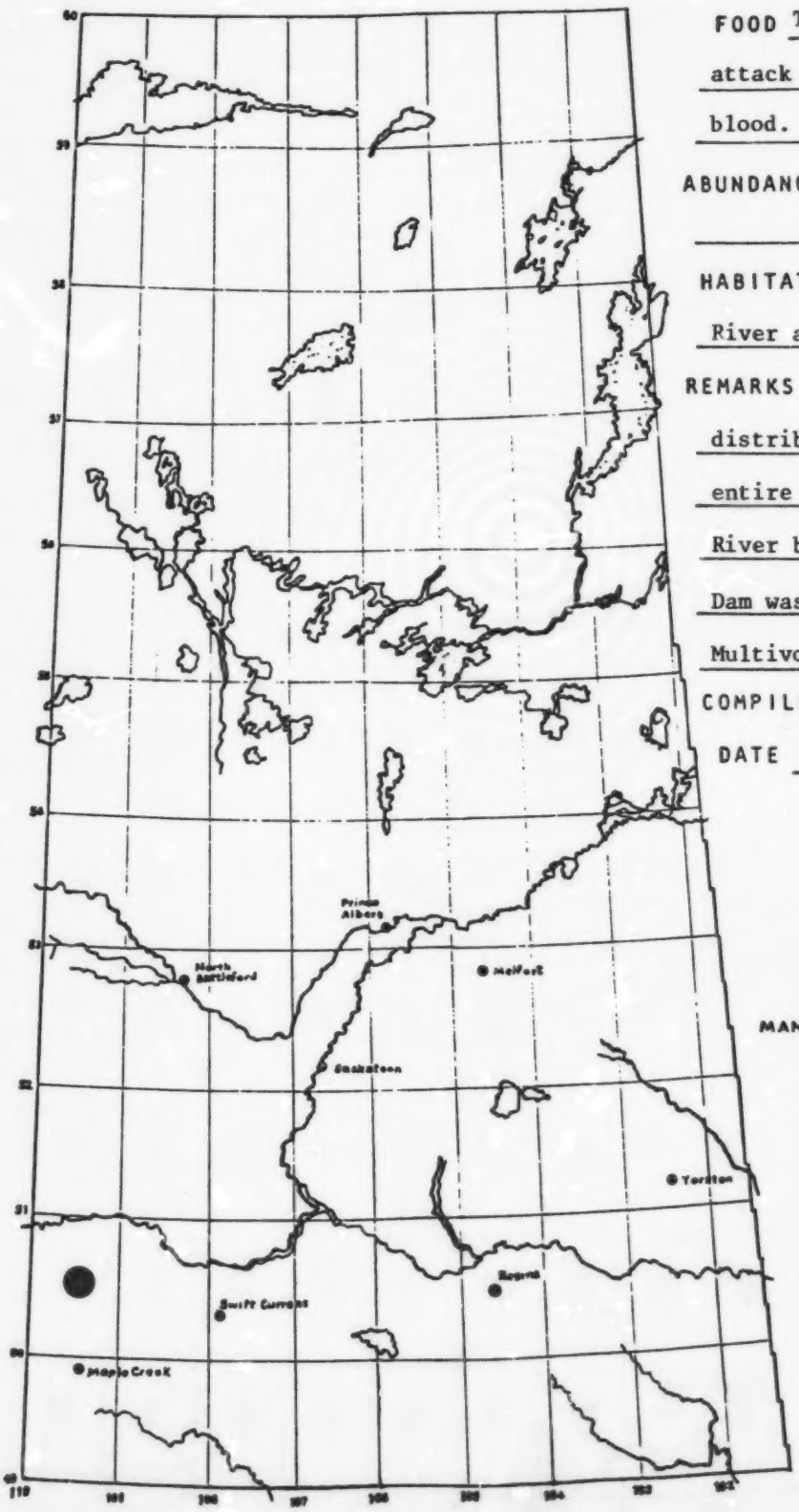
COMPILER F.J.H. Fredeen

DATE December 1981

SPECIES *Simulium (Psilopelmia) bivittatum* Malloch Map 16

COMMON NAME

SYNONOMY



FOOD The females attack mammals for blood.

ABUNDANCE Scarce.

HABITAT Saskatchewan River above Hind Lake.

REMARKS Larvae were distributed throughout entire South Saskatchewan River before Palliser Dam was closed in 1968. Multivoltine.

COMPILER F.J.H. Fredeen

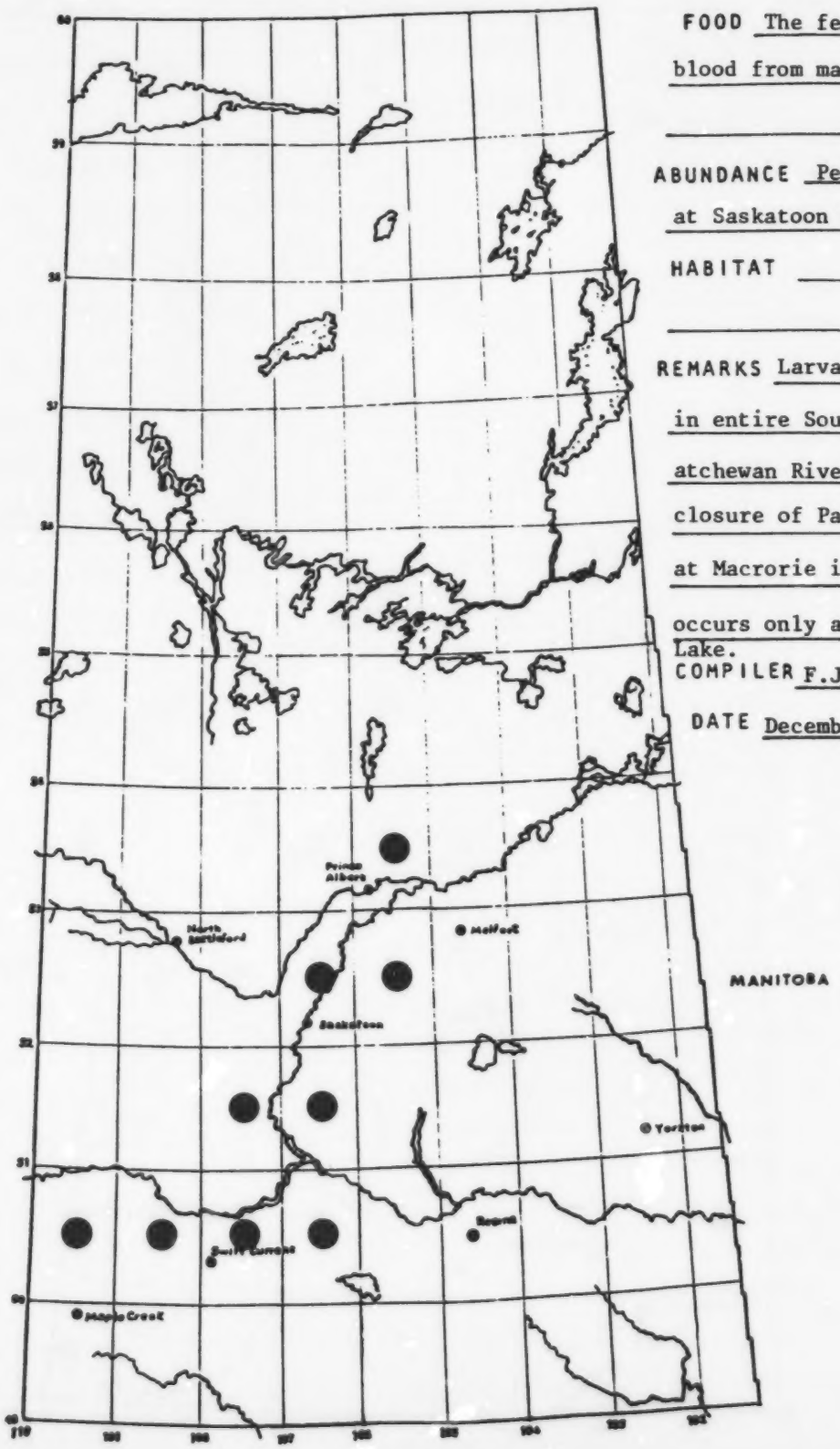
DATE December 1981

SPECIES *Simulium (Psilopelmia) griseum* Coquillett

Map 17

COMMON NAME

SYNONOMY



FOOD The females take blood from mammals.

ABUNDANCE Pestiferous at Saskatoon before 1968.

HABITAT

REMARKS Larvae occurred in entire South Saskatchewan River until closure of Palliser Dam at Macrorie in 1968. Now occurs only above Hind Lake.

COMPILER F.J.H. Fredeen

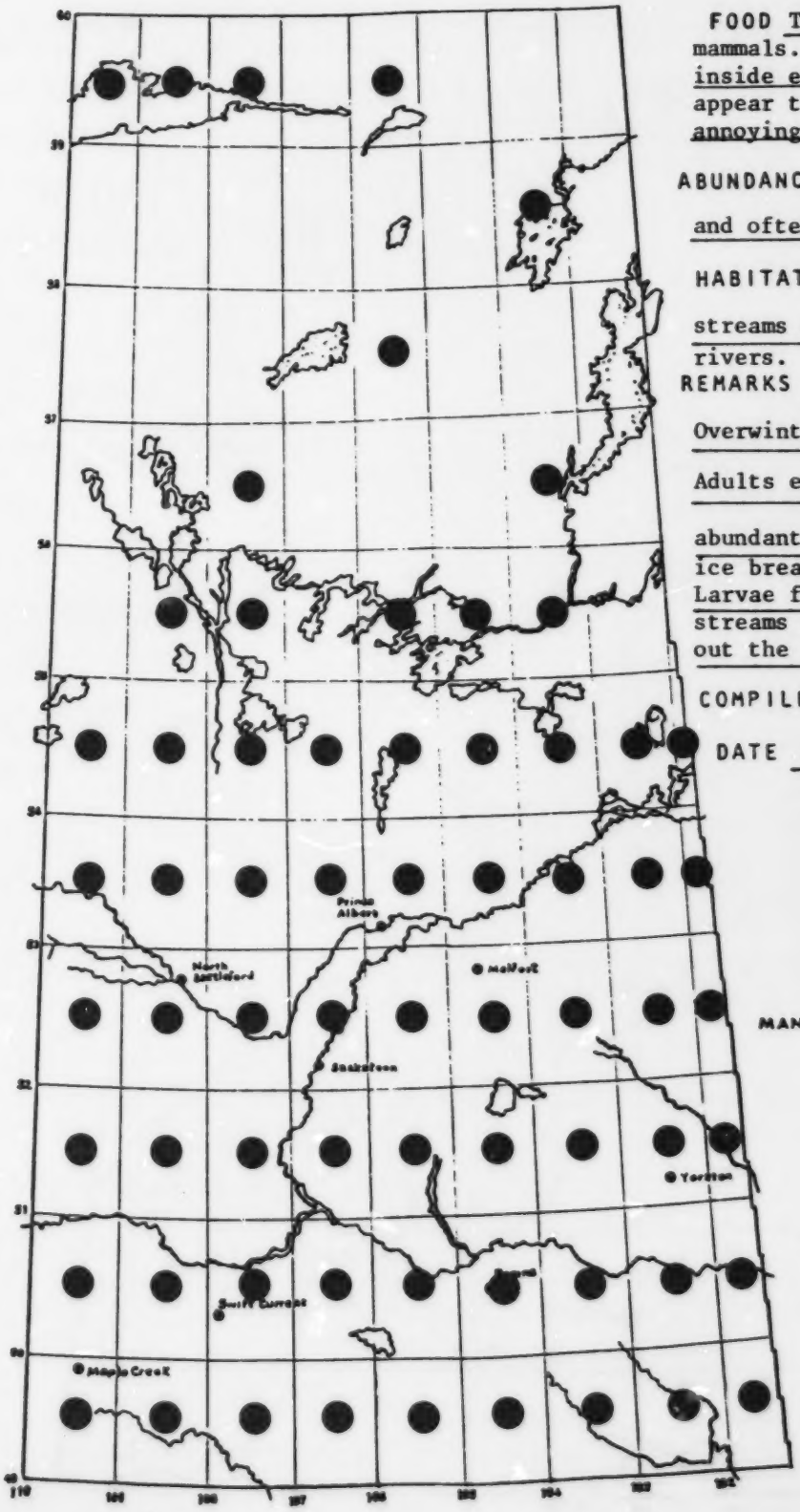
DATE December 1981

SPECIES *Simulium (Psilozia) vittatum* Zetterstedt

Map 18

COMMON NAME

SYNONOMY



FOOD Takes blood from mammals. Commonly feeds inside ears but does not appear to be too annoying.

ABUNDANCE Widespread and often abundant.

HABITAT Temporary streams to the largest rivers.

REMARKS Multivoltine. Overwinters as larvae. Adults emerge, sometimes abundantly, soon after ice break-up in spring. Larvae found in most streams and rivers throughout the province.

COMPILER F.J.H. Fredeen

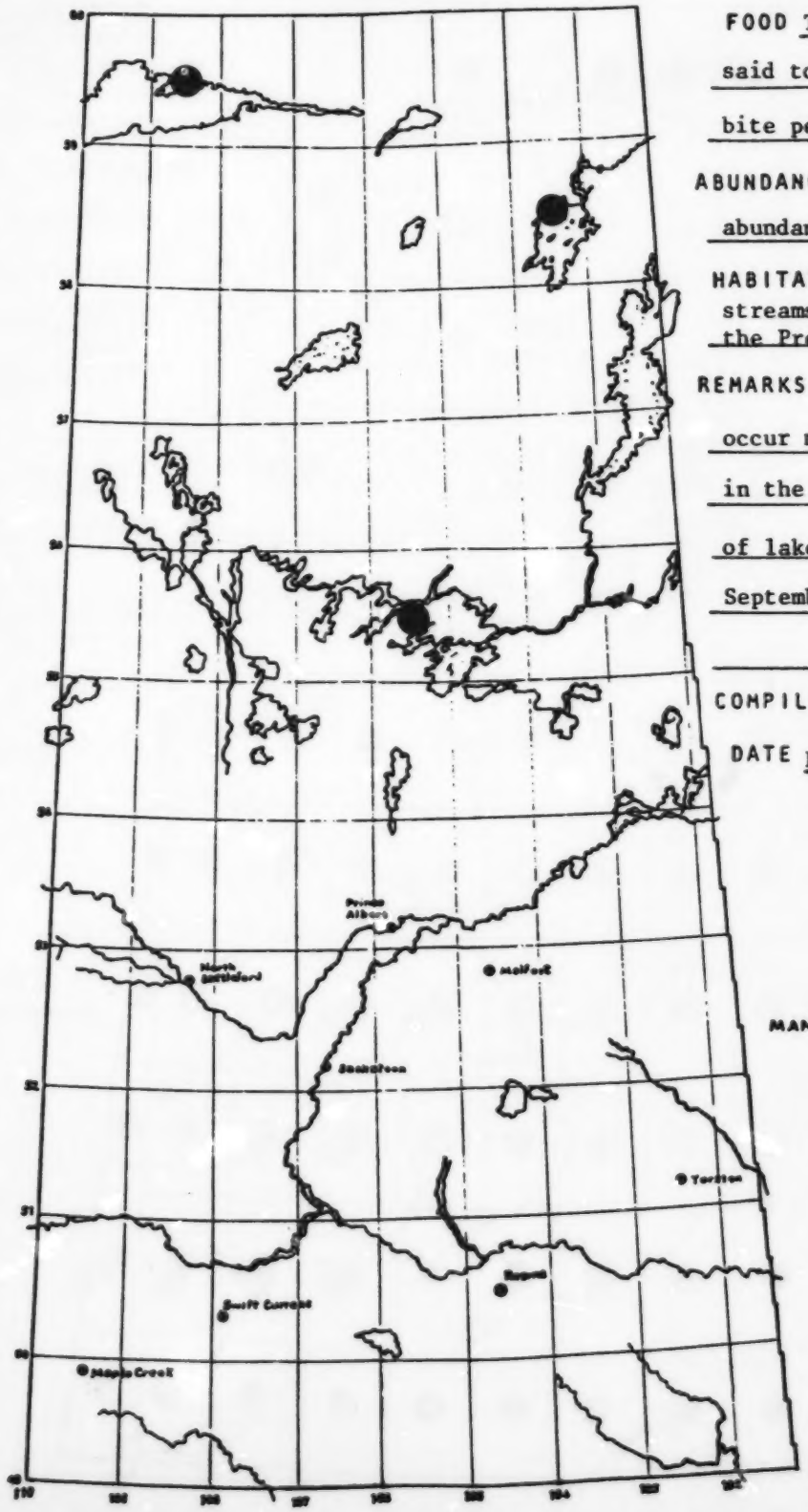
DATE December 1981

SPECIES *Simulium (Shewellomyia) longistylatum* Shewell

Map 19

COMMON NAME

SYNONOMY



FOOD The females are said to occasionally bite people.

ABUNDANCE Locally abundant.

HABITAT Permanent streams and rivers on the Precambrian Shield.

REMARKS The larvae occur most abundantly in the rocky outfalls of lakes, June to September.

COMPILER F.J.H. Fredeen

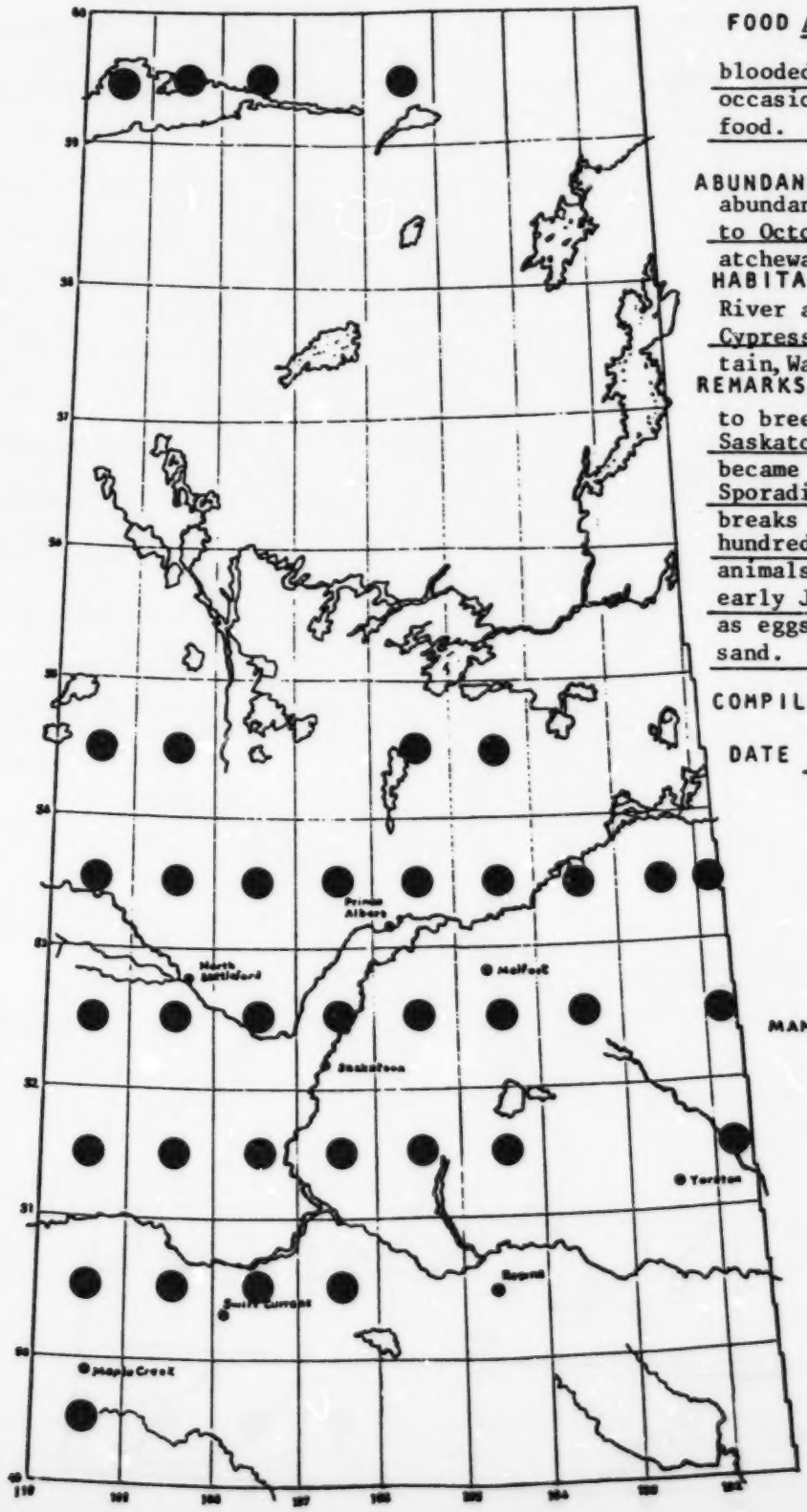
DATE December 1981

SPECIES *Simulium (Simulium) arcticum* Malloch

Map 20

COMMON NAME

SYNONOMY



FOOD Adults attack warm-blooded mammals and occasionally birds for food.

ABUNDANCE Can be very abundant and annoying May to October near the Saskatchewan River.

HABITAT Saskatchewan River and clear streams in Cypress Hills, Duck Mountain, Wapaweeka Hills, etc.

REMARKS These species used to breed abundantly in the Saskatchewan River, but became scarce in the 1970s. Sporadic widespread outbreaks sometimes killed hundreds of domestic animals in late May or early June. Overwinters as eggs in the river bed sand. Multivoltine.

COMPILER F.J.H. Fredeen

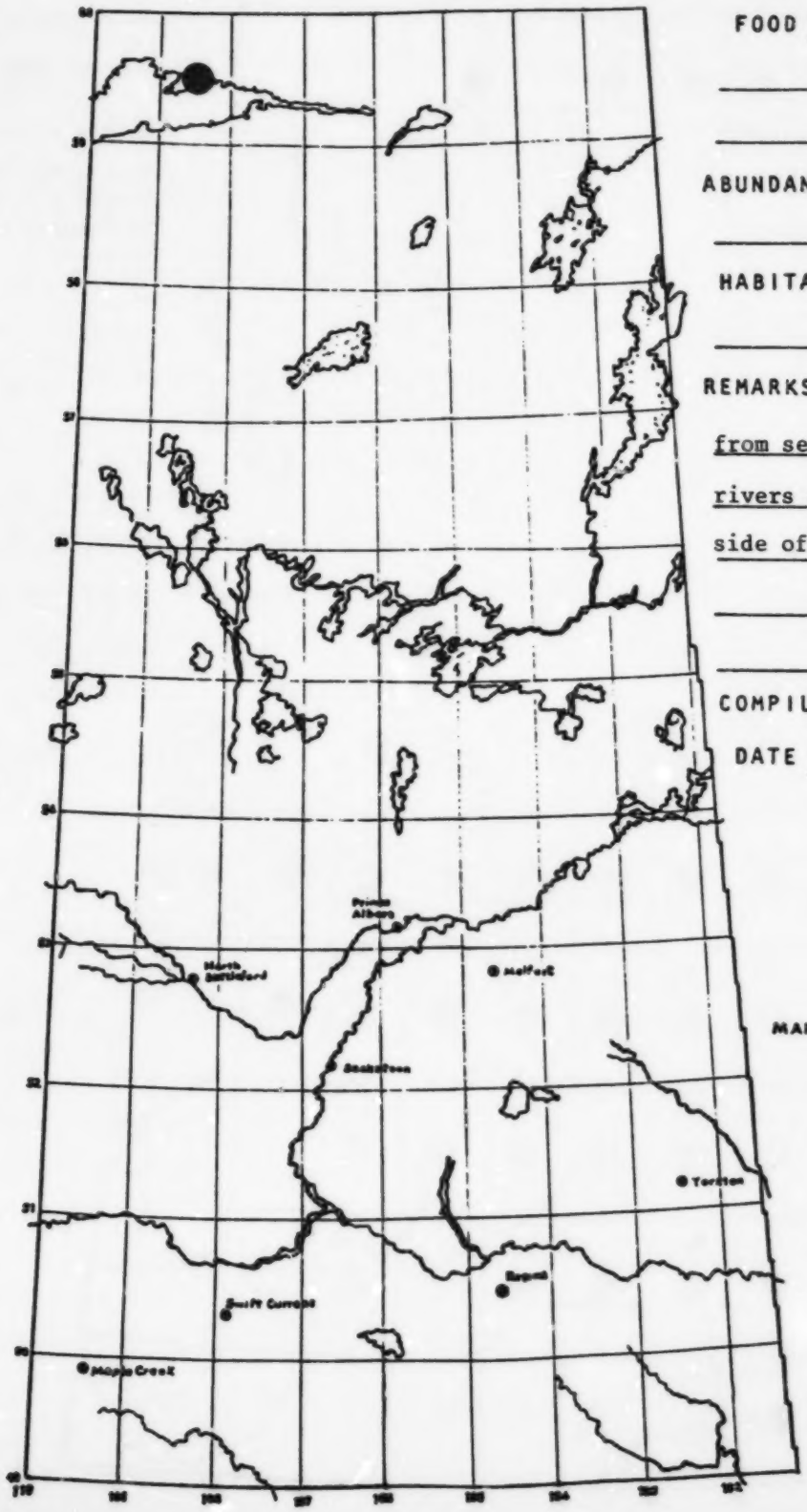
DATE December 1981

SPECIES *Simulium (Simulium) corbis* Twinn

Map 21

COMMON NAME

SYNONOMY



FOOD Unknown.

ABUNDANCE Scarce.

HABITAT Small rivers.

REMARKS Collected only from several small rivers on the north side of Lake Athabasca.

COMPILER F.J.H. Fredeen

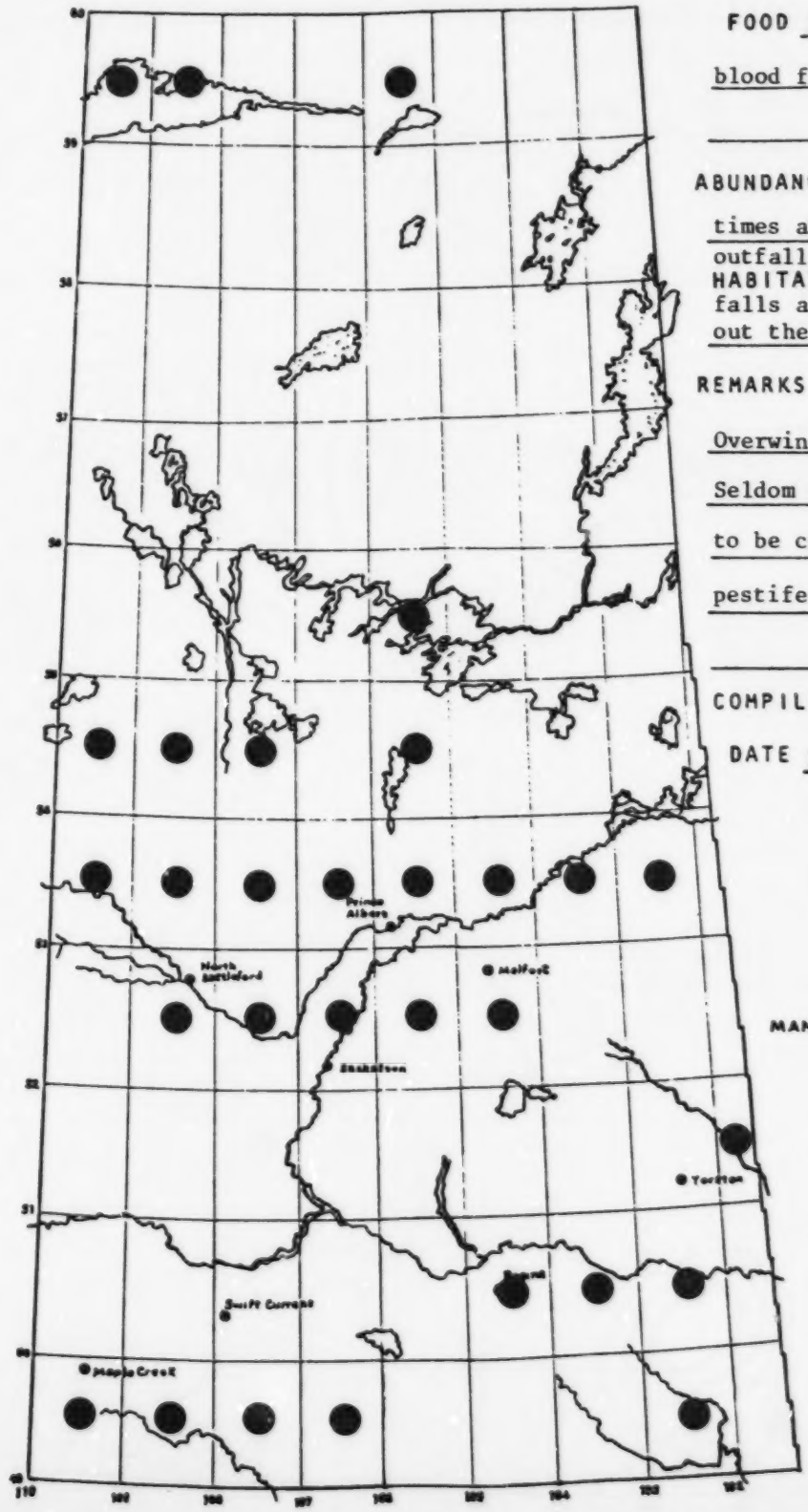
DATE December 1981

SPECIES *Simulium (Simulium) decorum* Walker

Map 22

COMMON NAME

SYNONOMY



FOOD The females take blood from mammals.

ABUNDANCE Adults sometimes abundant near lake outfalls.

HABITAT In lake outfalls and weirs throughout the province.

REMARKS Multivoltine. Overwinters as eggs. Seldom abundant enough to be considered pestiferous.

COMPILER F.J.H. Fredeen

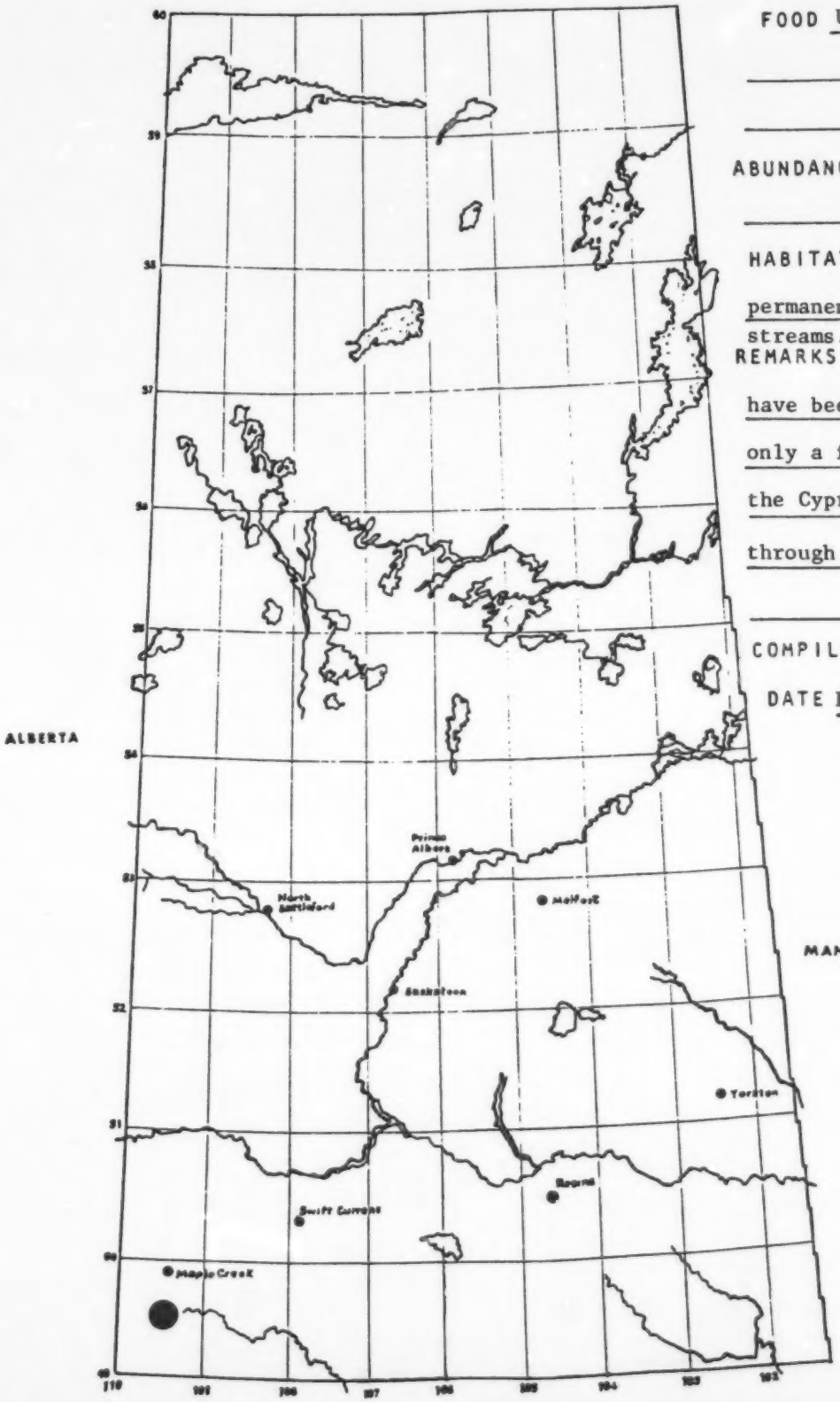
DATE December 1981

SPECIES *Simulium (Simulium) hunteri* Malloch

Map 23

COMMON NAME

SYNONOMY



FOOD Unknown.

ABUNDANCE Rare.

HABITAT Small permanent rivers and streams.

REMARKS The larvae have been collected from only a few streams in the Cypress Hills in June through August.

COMPILER F.J.H. Fredeen

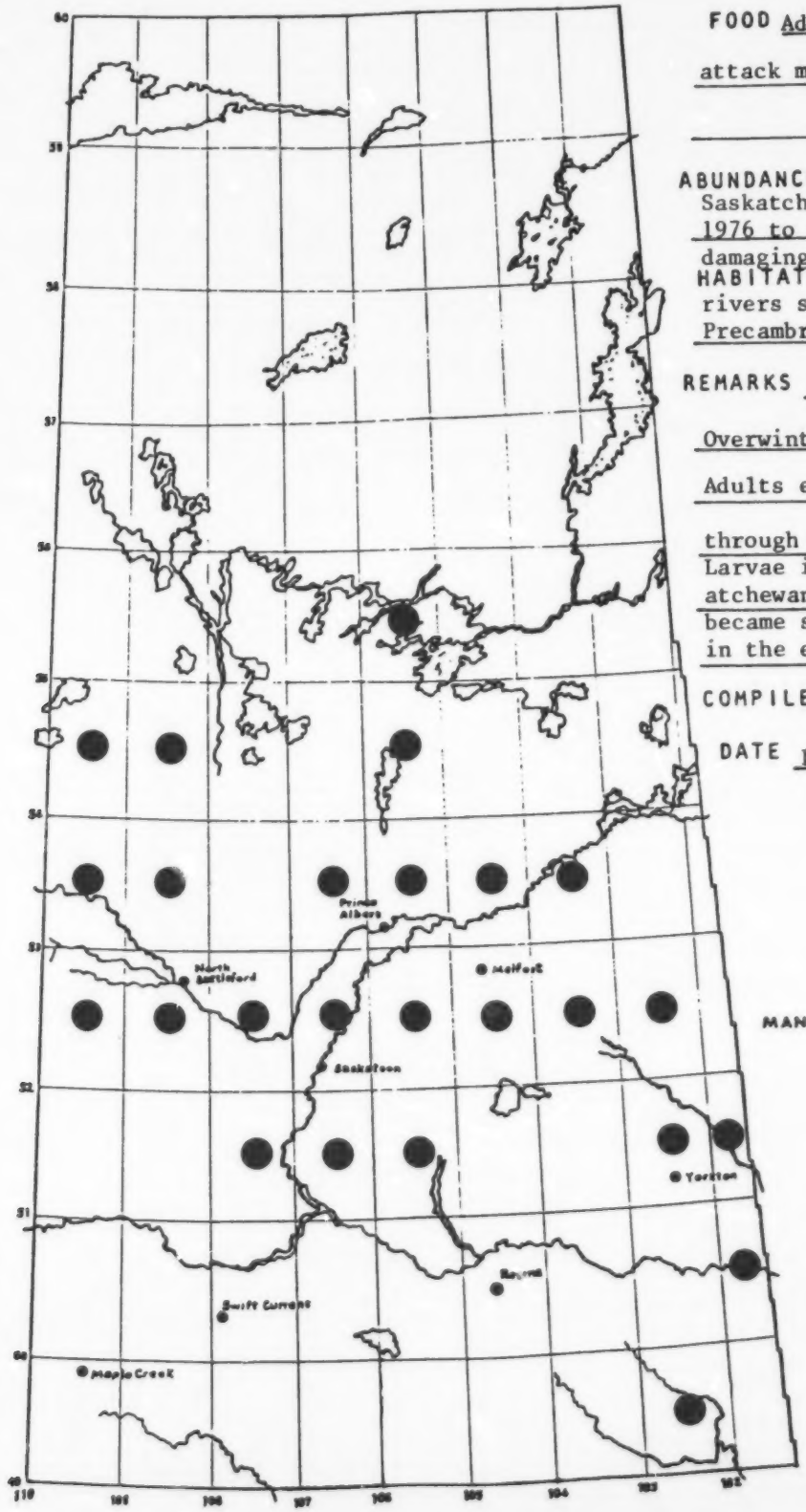
DATE December 1981

SPECIES *Simulium (Simulium) luggeri* Nicholson and Mickel

Map 24

COMMON NAME

SYNONOMY



FOOD Adults viciously attack mammals.

ABUNDANCE Larvae have been controlled in the Saskatchewan River since 1976 to reduce chances of damaging outbreaks.

HABITAT Shallow, weedy rivers south of the Precambrian Shield.

REMARKS Multivoltine. Overwinters as eggs. Adults emerge late May through September. Larvae invaded the Saskatchewan River when it became shallow and weedy in the early 1970s.

COMPILER F.J.H. Fredeen

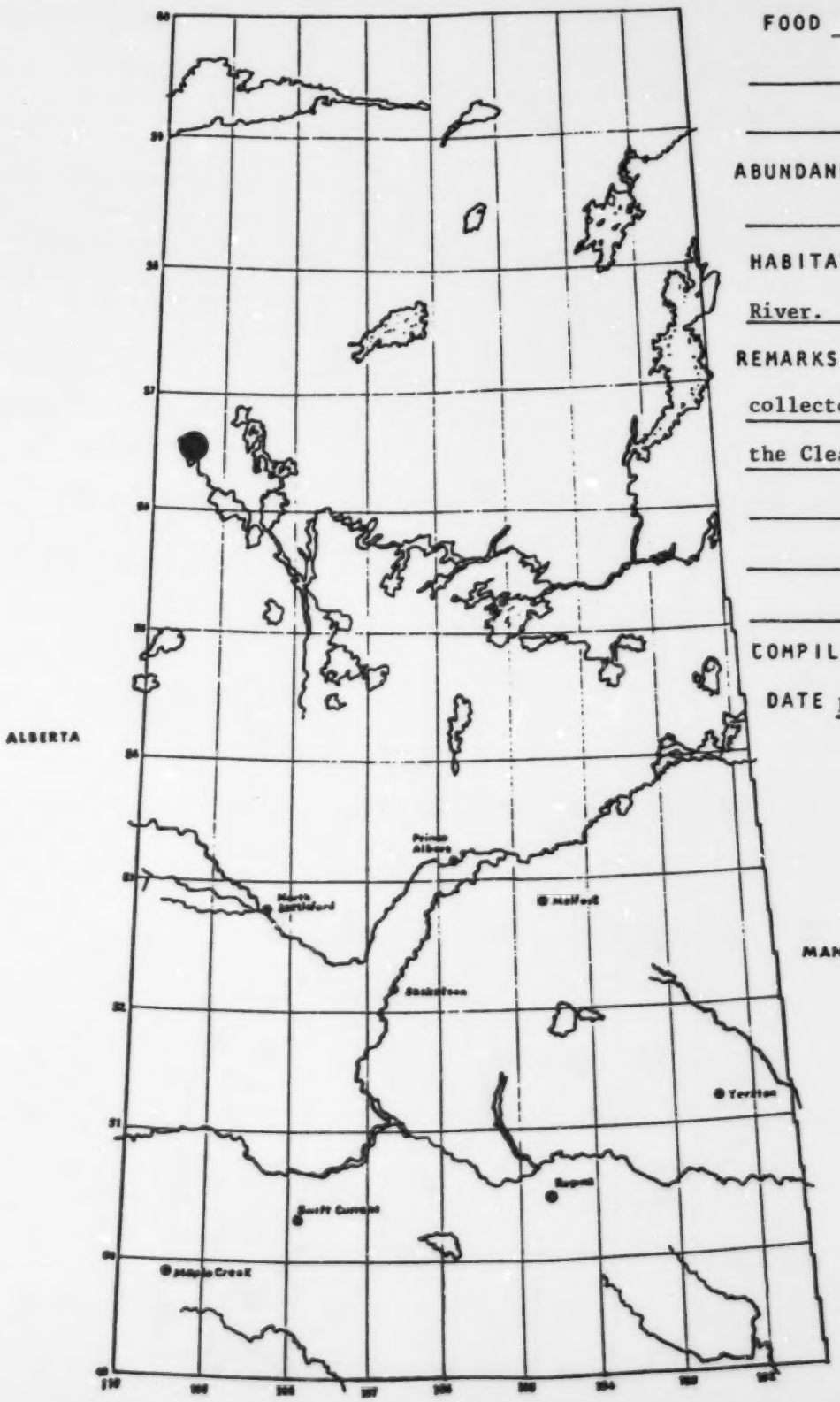
DATE December 1981

SPECIES *Simulium (Simulium) malyshevi* Dorogostajskij, Rubtsov and Vlasenko

Map 25

COMMON NAME

SYNONOMY



FOOD Unknown.

ABUNDANCE Rare.

HABITAT Clearwater River.

REMARKS Has been collected only from the Clearwater River.

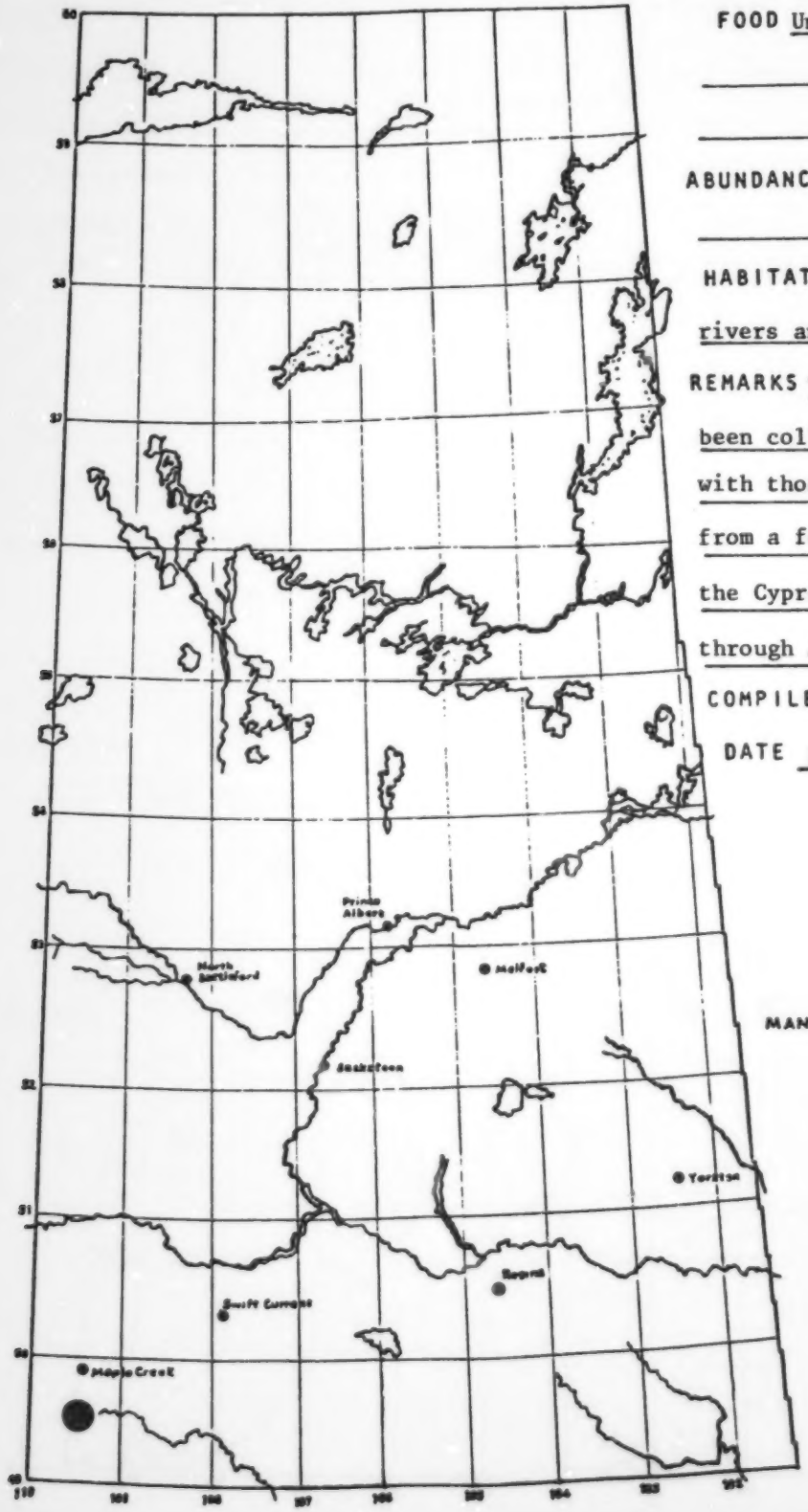
COMPILER F.J.H. Fredeen

DATE December 1981

SPECIES *Simulium (Simulium) piperi* Dyar and Shannon Map 26

COMMON NAME _____

SYNONOMY _____



FOOD Unknown.

ABUNDANCE Rare.

HABITAT Small permanent rivers and streams.

REMARKS The larvae have been collected along with those of *S. hunteri* from a few streams in the Cypress Hills, June through August.

COMPILER F.J.H. Fredeen

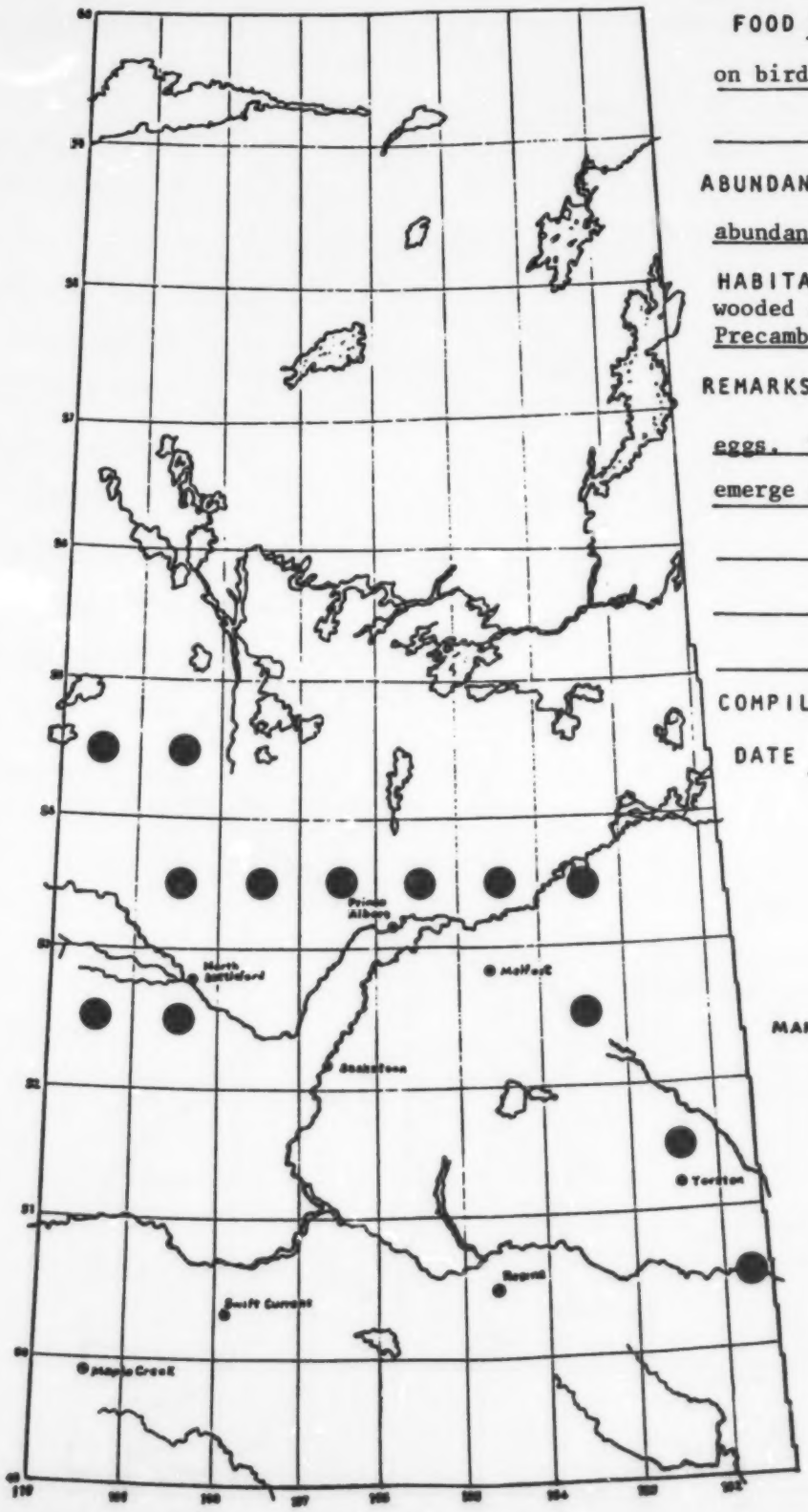
DATE December 1981

SPECIES *Simulium (Simulium) rugglesi* Nicholson and Mickel

Map 27

COMMON NAME

SYNONOMY



FOOD The females feed on birds.

ABUNDANCE Locally abundant.

HABITAT Small rivers in wooded areas south of the Precambrian Shield.

REMARKS Overwinters as eggs. The adults emerge in June.

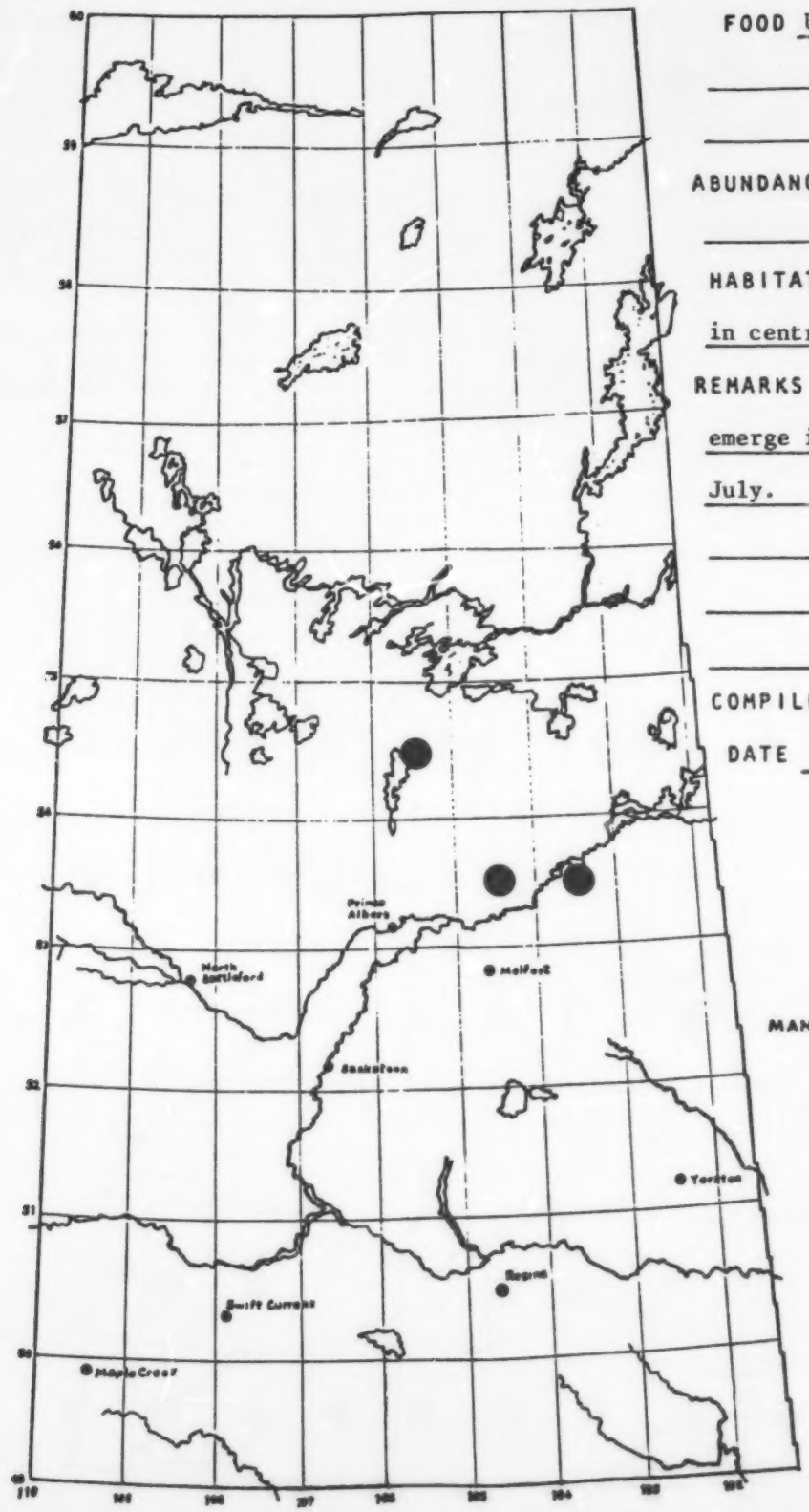
COMPILER F.J.H. Fredeen

DATE December 1981

SPECIES *Simulium (Simulium) transiens* Rubtsov Map 28

COMMON NAME _____

SYNONOMY _____



FOOD Unknown.

ABUNDANCE Rare.

HABITAT Small rivers in central Saskatchewan.

REMARKS The adults emerge in June and July.

COMPILER F.J.H. Fredeen

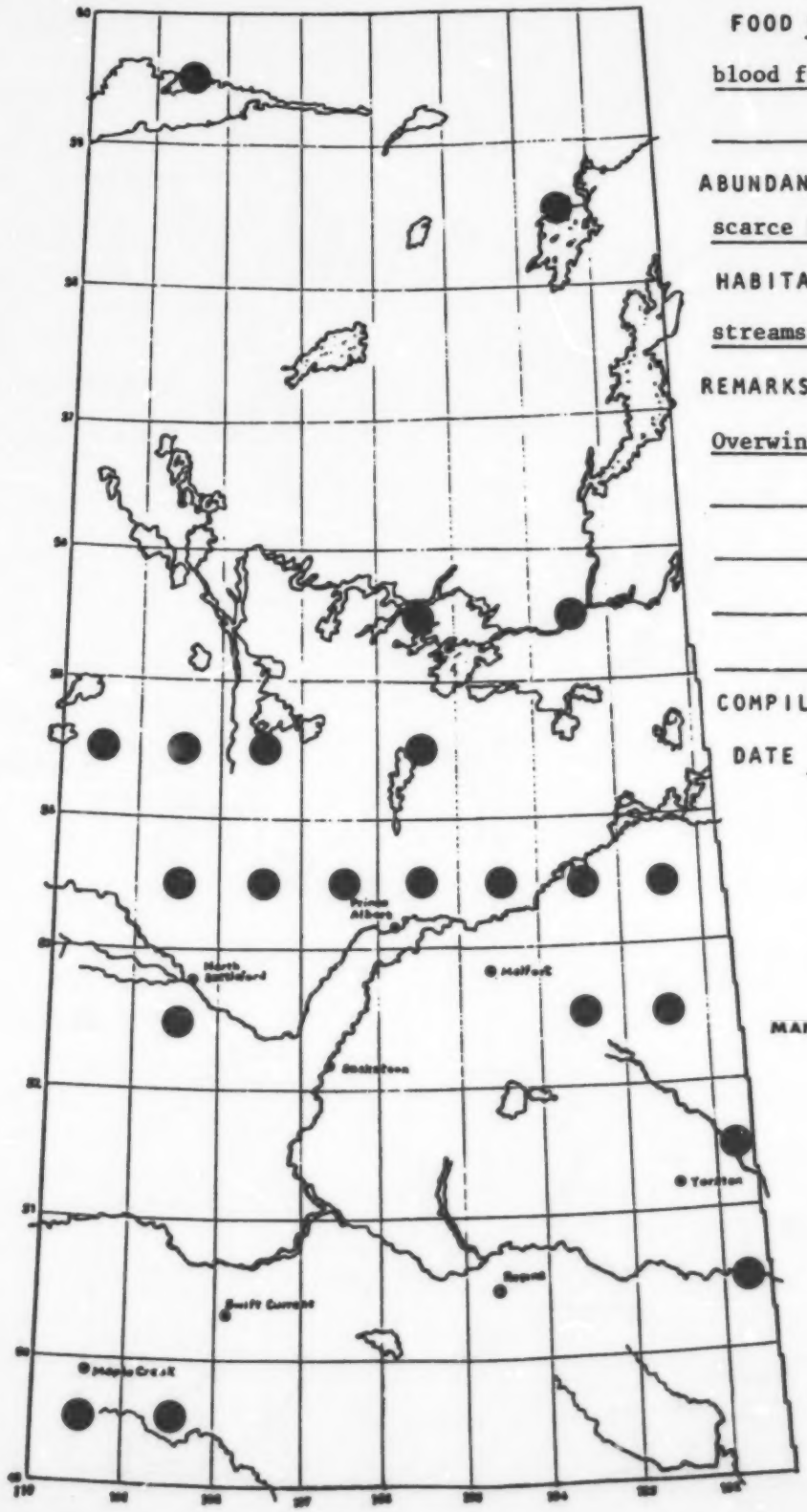
DATE December 1981

SPECIES *Simulium (Simulium) tuberosum* (Lundstrom)

Map 29

COMMON NAME

SYNONOMY



FOOD The females take blood from mammals.

ABUNDANCE Usually scarce but widespread.

HABITAT Permanent streams.

REMARKS Multivoltine. Overwinters as eggs.

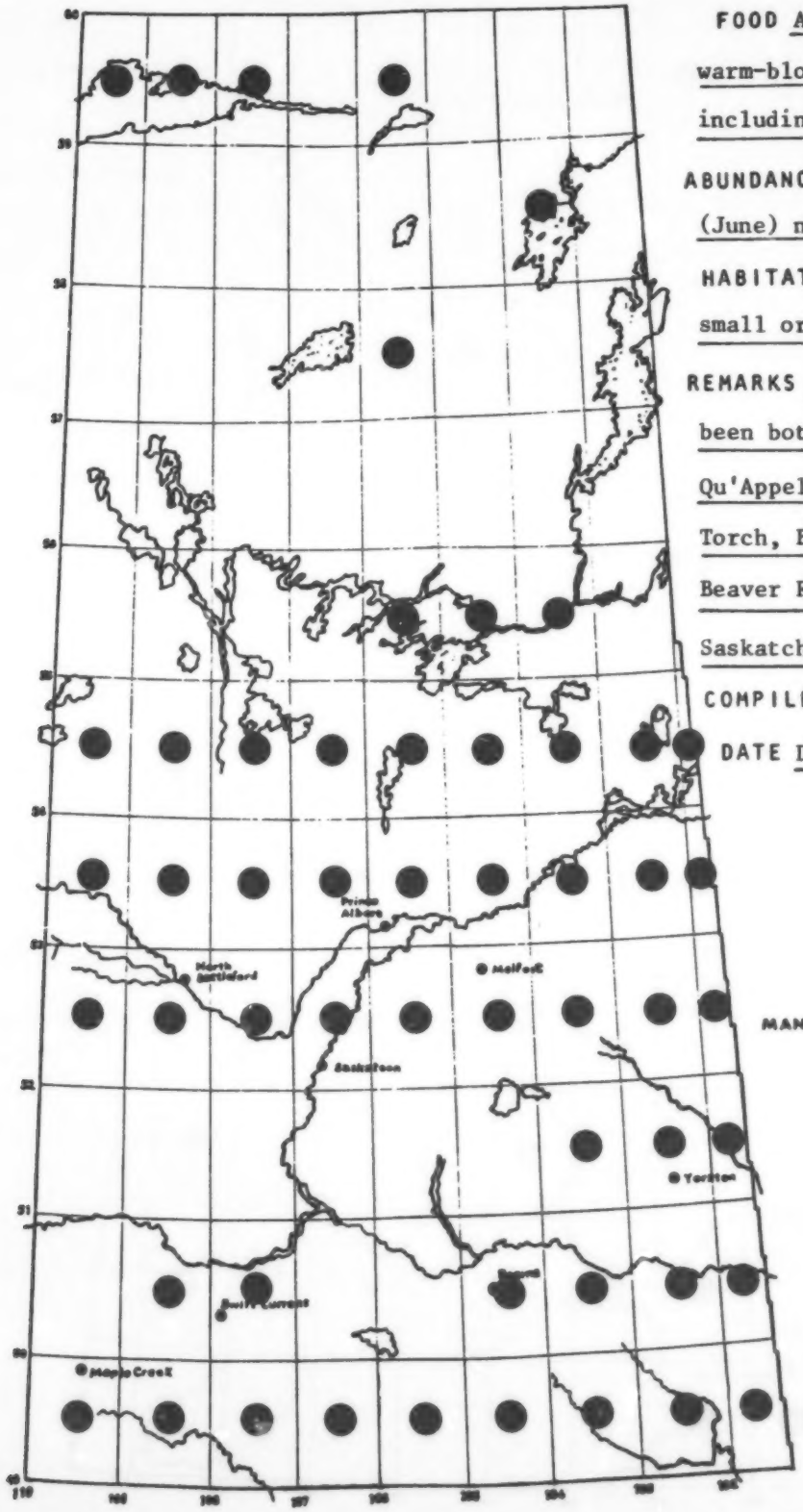
COMPILER F.J.H. Fredeen

DATE December 1981

SPECIES *Simulium (Simulium) venustum* Say Map 30

COMMON NAME _____

SYNONOMY _____



FOOD Adults feed on warm-blooded mammals, including man.

ABUNDANCE Briefly adundant (June) near small rivers.

HABITAT Larvae found in small or medium sized rivers.

REMARKS Occasionally has been bothersome near the Qu'Appelle, Assiniboine, Torch, Battle, Big and Beaver Rivers in Saskatchewan.

COMPILER F.J.H. Fredeen

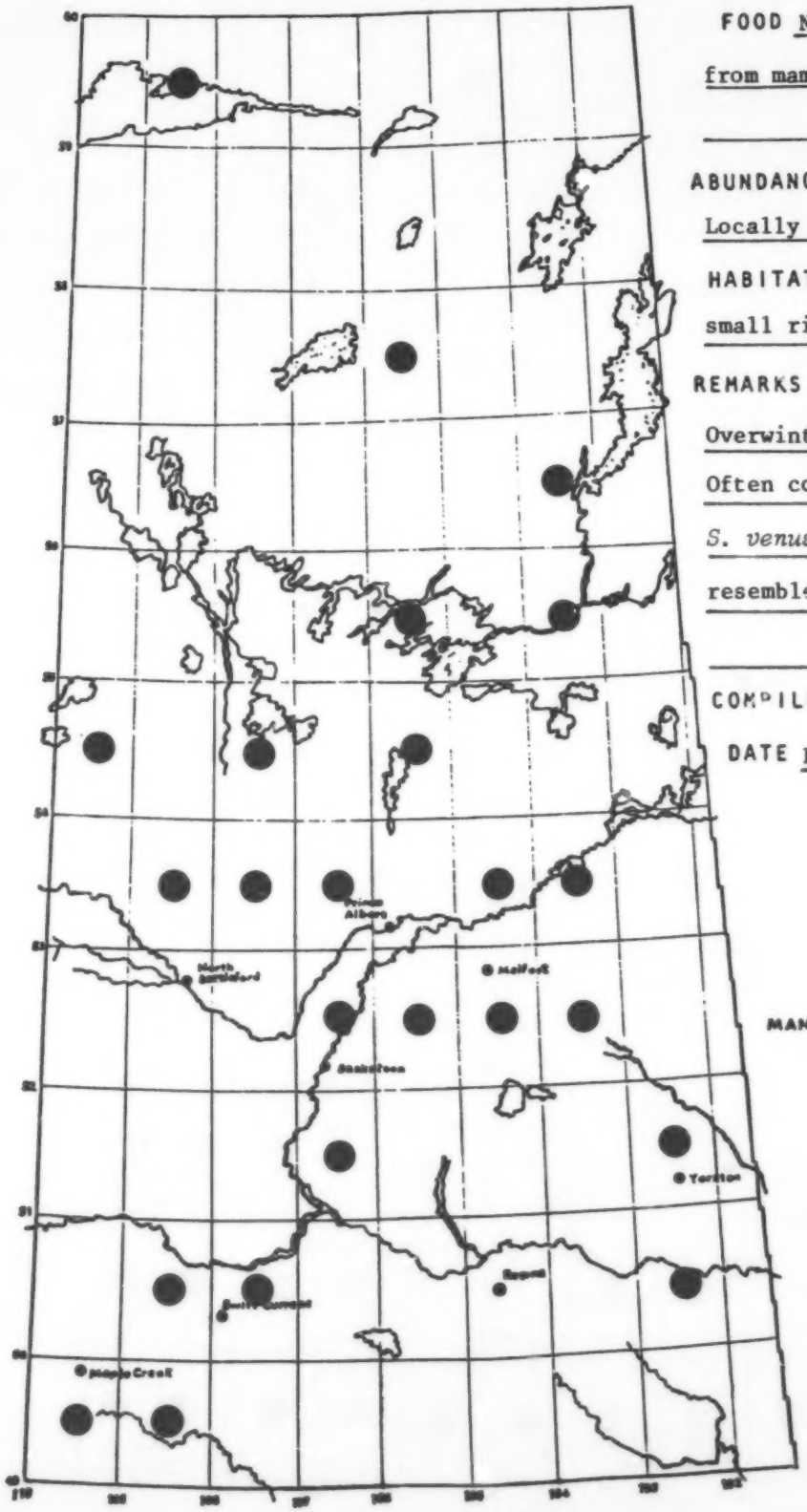
DATE December 1981

SPECIES *Simulium (Simulium) verecundum* Stone and Jamnback

Map 31

COMMON NAME

SYNONOMY



FOOD Not collected from mammals or birds.

ABUNDANCE Widespread. Locally abundant.

HABITAT Streams and small rivers.

REMARKS Multivoltine. Overwinters as eggs. Often confused with *S. venustum* which it resembles.

COMPILER F.J.H. Fredeen

DATE December 1981